BULLETIN

OF THE

AMERICAN ASSOCIATION

OF

JESUIT SCIENTISTS

Eastern States Division

VOLUME 40 March, 1963 NUMBER 1

Bulletin of the American Association of Jesuit Scientists

Eastern States Division

(FOUNDED IN 1922)

For Jesuit use only

Editorial Office
Woodstock College
Woodstock, Maryland

Second-class postage paid at Woodstock, Maryland. Published quarterly at Woodstock College, Woodstock, Maryland, by the American Association of Jesuit Scientists (Eastern States Division).

Annual dues for members of the Association are $6.00. A subscription to the BULLETIN is included among the privileges of membership.

To our readers . . .

The recent questionnaire sent to readers of the BULLETIN provoked many interesting comments, suggestions, and criticisms. In this issue the results of the questionnaire are summarized, and some comments made on the future of the BULLETIN.

The dedication of Georgetown University's new science building was the occasion of three excellent addresses, all of which have been made available to our readers through the kindness of Fr. Daniel Power, S.J. and the three distinguished speakers. Fr. Bunn introduces the theme of "unity in diversity" so well developed by Dr. Seaborg in the main address. Rev. Fr. Provincial of the Maryland Province briefly chronicles the contributions of outstanding Jesuit scientists before commenting on the vocation of the scientist.

The priest-scientist theme is taken by Fr. Meissner from a psychological viewpoint, with particular application to the Jesuit. His treatment complements previous BULLETIN articles on this subject which the questionnaire revealed to be of considerable interest to our readers.

Fr. Lynch surveys the activities of the Jesuit Seismological Association in a field which has long been witness to outstanding contributions by members of the Society. Fr. Lynch's own contributions have recently earned him the honor of being elected president of the New York Academy of Science.

Another outstanding Jesuit, Fr. Patrick Yancey, S.J., chairman of the biology department at Spring Hill College, was honored by scientists and friends in a two-day celebration, October 20–21, commemorating his fiftieth anniversary as a Jesuit. Fr. Yancey is a former member of the NSF board and a past president of both the Alabama Academy of Science and the Mobile Academy of Science.

The BULLETIN extends congratulations to both Fr. Lynch and Fr. Yancey.

We are initiating several new features in this issue. An annotated bibliography of pertinent educational and scientific articles appearing in the periodical literature from September to December 1962 is presented on a trial basis. In compiling the bibliography the aim has been to list only articles of a more general nature. Familiarity with the literature immediately pertinent to one's own work is presumed.

An annotated list of government brochures on various topics of interest to scientific educators will, we hope, be of assistance to our readers. So too the brief report on some interesting programs that have come to our attention from various schools throughout the country.

Let us hear from you, so that a letter-to-the-editor section, frequently requested by respondents to the questionnaire, may also become a regular section of the BULLETIN.

REPORT ON THE QUESTIONNAIRE

In an attempt to determine reader interest in and reaction to the BULLETIN for the past two years, approximately 350 copies of a brief questionnaire were sent to our readers. Six weeks later one hundred replies had been returned. Quite possibly, this thirty percent response is not too poor for a typical mailing venture. However, the questionnaire had been extremely brief, and especially adapted for quickly answering whether or not one read the BULLETIN and found it helpful. Hence one might suspect the worst, namely, that over two-thirds of those contacted were not sufficiently interested in the BULLETIN to reply.

If the returned questionnaires had not been so enthusiastic and helpful in their constructive criticisms and suggestions, it might well be argued that the BULLETIN was not responding to a felt need, and hence should be dropped or at least drastically changed. The present investment of time and money could not be justified if only one hundred or so Jesuits were finding the publication helpful. A simpler, more economical medium of communication would have to be found. This is not meant to be overly pessimistic, nor is it meant to be a criticism of those not responding to the questionnaire. The latter may have spoken most eloquently through their silence. Nevertheless, the many fine ideas advanced in the returned questionnaires would seem to demand a trial, and the BULLETIN staff will attempt to carry out as many of these ideas as possible in the coming year. Then, perhaps another "agonizing reappraisal" will be in order. Of course, at issue here is not the perpetuation of this publication, come what may; rather, it is to find whatever means are conducive to the goals of Jesuit scientists, corporately and individually.

The issues raised by the questionnaire are significant, too significant to be restricted to discussion solely by the small editorial staff of the BULLETIN. Therefore, we invite all members of the Association to communicate to the editor their views on what is presented in this report. Only to the extent that our readers respond to them can a realistic evaluation of the issues be made.

Classification of reader response. The respondents to the questionnaire represented a fair cross section of the Association, as can be seen from Table I (column one). Included there is a tabulation (columns three and four) of the answers to question three of the questionnaire: "Do you read the BULLETIN?"

TABLE I

Classification	Number Responding	Percent Responding	Number Reading Articles	Number Reading Reports
			(Brackets refer to	"sometime" readers)
High School	18	20	14 (2)	15 (2)
College and University	34	34	21 (9)	33 (1)
Graduate Student	14	31	11 (2)	12 (1)
Theologian	23	35	19	18 (4)
Other:				
Tertian	5	45	2	5
Philosopher	1	?	1	1
Province Prefect	3	23	3	3
No longer teaching science	3	?	2	1

Conclusions from the above table can only be tentative since an adequate sampling has not been obtained. It is suggested, however, that 1) high school teachers are considerably less satisfied with the BULLETIN than other readers; 2) articles are not as widely read as the "Reports of scientific activity"; 3) at least eighty percent of the respondents read both articles and reports, with the exception of the tertians and college teachers, only forty and sixty-three percent of whom read the articles. The significance of these conclusions will be discussed below.

Is the *Bulletin* helpful? There were only a few negative answers to this fourth question. One reason cited was that the lack of definite purpose in the BULLETIN, and, more fundamentally, in the Association itself resulted in no unique service being rendered by either. This problem was also raised several times in response to the fifth and sixth questions. Two readers found the BULLETIN was not helpful because it was too heavily weighted towards the physical sciences, ignoring the behavioral sciences. This too is a limitation in the Association.

On the positive side, readers finding the BULLETIN helpful most commonly cited as their reason the information and interest they derived concerning the activities of other Jesuits and Jesuit schools. Stimulation and emulation were also cited, as was usefulness in counseling students about Jesuit colleges and universities. Many cited individual articles as being helpful, with the articles on the priest-scientist most often being mentioned. Some readers found the BULLETIN useful in offering new ideas and developing old ones, and in communicating observations to other Jesuits. The BULLETIN was seen as keeping alive a sense of corporate Jesuit enterprise in science, and symbolizing the Association and a hoped-for growth in the latter.

What do you dislike about the *Bulletin*? Question five may have intimidated readers, since the favorite responses were "nothing" or a blank space. One might have expected from Table I that high school teachers would have some common objections to the BULLETIN. This was not the case. In fact no one classification could be identified with any one reason for disliking the BULLETIN, nor was any one reason predominant. Four readers did not like the abstracts of research and theses; two objected to the delay between submitting reports and seeing them appear in the BULLETIN; and three cited the lack of definite purpose in this publication and in the Association. All other objections were by single individuals, yet some would seem to merit general attention. They include: 1) not enough articles dealing with problems peculiar to Jesuit schools; 2) the incompleteness of many articles and the lack of references; 3) too restricted coverage and private circulation; 4) the cost which prevents distribution of the BULLETIN to Jesuits throughout the country.

Suggestions. Readers were most helpful in answering the sixth question, a request for ideas on improving the BULLETIN. The responses might conveniently be broken down into suggestions for 1) articles; 2) features; 3) surveys; 4) general improvement of the BULLETIN.

Many asked that the number of articles be increased, and of the numerous suggestions for particular articles the following stand out:

1) further exploration of the priest-scientist theme (including a "theology" of science);

2) reprints of significant addresses and other items not otherwise available;

3) articles of an interdisciplinary nature;

4) a report on the Jesuit Research Council;

5) more interviews, e.g., with deans, rectors, provincials, etc.;

6) articles of a provocative nature, e.g., offering the pros and cons of various high school programs, or a discussion of the biology major in our colleges;

7) a series of monographs on outstanding Jesuits in the history of science;

8) a collection of information on acquiring and using grants, fellowships, etc.;

9) discussion of the course of studies for the Jesuit scientist;

10) discussion of the problems of communication between: various disciplines, high school and college, Jesuit and non-Jesuit schools, lay and Jesuit faculty;

11) articles on general areas of research, e.g., term papers submitted by graduate students;

12) reprints of major papers published from our schools.

(This lengthy though not complete list is included here in the hope that our readers will find themselves interested enough in one or more topics to submit an article to the BULLETIN.)

Of the feature sections suggested for the BULLETIN a letter-to-the-editor section and an annual listing of members with their current status etc. were most frequently mentioned. The former was seen as a complement to provocative articles on timely subjects which should evoke reader response. Other suggestions included sections devoted to:

1) an exchange of ideas on computer use;
2) classroom notes, e.g., the presentation of difficult topics;
3) activities for high school science clubs;
4) reports on high school texts;
5) openings for lay faculty;
6) individuals' evaluation of summer institutes, research and post-doctoral fellowships, exchange professorships, etc.;
7) obituaries of outstanding members of the Association;
8) book reviews.

Several readers suggested surveys to be made by the BULLETIN, especially of Jesuit scientific personnel and the offerings of Jesuit science departments in the United States and Canada. Also mentioned was a survey conducted among our former students to determine the adequacy of their preparation for college or graduate studies.

The most significant suggestion for the general improvement of the BULLETIN concerned the specification of the aims of first the Association and then of the BULLETIN. This need for setting the objectives of the AAJS and then analyzing progress made towards achieving them was echoed in many of the questionnaires under questions four, five, and six. Closely linked with this was the desire of many to expand the Association to embrace the other provinces throughout the United States and Canada.

Several suggested limiting this publication to news items and publishing them in mimeographed form, showing that not all wanted an expansion in the number of articles. The "Reports on scientific activity" were themselves a matter of some dispute. Some wished them shorter, others longer; some thought them too technical, others not technical enough; one more irenic reader suggested a more descriptive summary to accompany technical abstracts. Contributions from lay faculty members were recommended by at least one respondent.

As with the reasons for liking or disliking the BULLETIN, the suggestions for improving it could not be identified with any one group of readers.

Editorial response. Before a brief commentary on the summarized results of the questionnaire, an obvious word of gratitude is due to all who replied to the questionnaire and contributed their comments and suggestions. The BULLETIN staff will attempt to act upon as many of these as possible, at the same time trying out a few new ideas of its own. The following remarks should be considered preliminary to a further analysis of the significance of the response to the questionnaire.

The responses to questions two and three (Table I) assure us that eighty or more readers find the BULLETIN helpful, but tell us nothing of the usefulness it has for the great majority of those receiving it. The optimism and enthusiasm of the eighty-plus would seem to justify the continuation of the BULLETIN for at least another year. The relatively small number of high school respondents indicates, perhaps, a lesser interest in the BULLETIN on the part of this group.

Usefulness of the *Bulletin*. Question four on the helpfulness of the BULLETIN uncovered a common complaint running through the responses to other questions as well, namely, the lack of specific goals both for the American Association of Jesuit Scientists and the BULLETIN. This is a very complex question which cannot be treated adequately here. It has come up at past meetings of the Association and has probably never been satisfactorily answered. We hope that our readers will accept the invitation to write to the editor and thus participate in a joint effort to clarify this question. On the basis of the responses we receive we will treat this problem further in the next issue.

The complaint of neglect for the behavioral sciences is objectively valid in that the Association and the BULLETIN have, at least in recent years, limited their interests to the mathematical and natural sciences. However, this was not meant to be prejudicial to the behavioral sciences and certainly interdisciplinary discussion is welcomed. The respondents citing this problem have kindly offered their help in trying to solve it, or at least to clarify it.

Those finding the BULLETIN helpful expressed as their reasons what are certainly legitimate aims, if not *the* aims of both the Association and the BULLETIN, namely, the stimulation and emulation derived from contact with the activities of other Jesuit scientists.

Dislikes. Steps have been or are being taken to eliminate the basis for the dissatisfaction expressed by readers in responding to question five. The time lag between submitting material and publication of the BULLETIN (a problem for both readers and staff!) has been shortened to allow one month between the publication of one issue and the deadline for the next issue. This will permit a letters-to-the-editor section. Attempts will be made in future issues to include a brief description with the technical abstracts. This will not always be possible and readers are then asked to be patient for the sake of the few who will find such material helpful. The problem of defining the precise purpose of the BULLETIN has been discussed above.

The difficulties of the small number of articles and their incompleteness can best be removed by our readers themselves, who, for the most part, are also our contributors. So too the restricted coverage of news items is a problem best solved by our readers' cooperating with the news correspondents in each school or department. The cost of the BULLETIN is an obstacle to its wider distribution throughout the country. Hopefully, financial arrangements can be made in order to get the BULLETIN to anyone wishing a copy. This is also related to the problem of the expansion of the Association (see below).

Suggestions. The long list of suggested articles will, we hope, encourage our readers to contribute articles to the BULLETIN. The present issue has anticipated some of the requests with an article on the priest-scientist and a reprint of three significant addresses. An article on the Jesuit Research Council is planned for a subsequent issue. The staff will follow the other suggestions in soliciting articles in the future, but would also ask interested readers to submit material. Two suggestions concerning articles would not seem to be in keeping with the aims of the BULLETIN, namely, the suggestions to reprint papers published from our schools and to publish graduate student term papers on general areas of research. While allowing for exceptions, it would appear to be preferable to print an abstract of the former, referring the reader to the original article, and the latter, if good enough, should probably be printed in a journal of wider circulation, again with an abstract being published in the BULLETIN. We would also prefer to encourage our readers to publish book reviews and "classroom notes" in journals of wider circulation.

Suggestions have been made for a letters-to-the-editor section. We have already indicated at the beginning of this report how important we feel this to be in order to clarify the situation of both the Association and the BULLETIN. Our readers are encouraged to write letters-to-the-editor on any material discussed in the BULLETIN or any other material which they feel to be of common interest to BULLETIN readers.

Of the suggested surveys the one concerning Jesuit science departments is now in progress, and should be ready for the next issue. If time permits others will follow.

The most recurrent of the general suggestions for the BULLETIN, namely, a clear definition of the purpose of the Association and the BULLETIN has been considered above. The closely related problem of expanding the Association is under consideration by many throughout the country, especially in California, and we hope to have a report on that by the next issue.

This is our reaction to the results of the questionnaire. We await yours.

DEDICATION OF THE GEORGETOWN SCIENCE BUILDING: WELCOMING ADDRESS

EDWARD B. BUNN, S.J.

This is a day of jubilation for Georgetown, of thanksgiving and of dedication. In this Hall of Science and Research, which today we formally welcome and induct into the University complex, adding to our venerable Campus its own solid strength, majestic beauty, and enhanced capacity for service, Georgetown envisions the realization of a long-cherished ambition, the widening horizon of forward-looking expectations.

Fifteen hundred years ago, the great Bishop of Hippo, Augustine, on a similar occasion, spoke a brief sentence which to me sums up the entire spirit of this day, and which I am happy to see incorporated into the dedication program of these exercises: "*Aedificium, immo aedificatio, habet laborem; dedicatio exsultationem.*" A building, in its construction, entails prodigious labor, but in its dedication communicates sheer joy and exultation.

For myself, to be briefly personal, I can say with deep and earnest sincerity that no event of the past ten years has given me the intense satisfaction and sense of gratitude afforded by this occasion; to none have I looked forward with more eagerness, as a prime intention of my tenure as president. As I have said many a time before, while I may not yet, in the designs of Providence, be ready to say a *Nunc dimittis*, I can from the depths of a grateful heart say a most fervent *Magnificat*.

Needless to say, our first thought of gratitude rises to God, the Creator, and the Giver of every good and perfect gift. Very shortly I shall have the happy privilege, in the short but lovely ritual of blessing the building, of consecrating, as spokesman for Georgetown, all that this building stands for, and all that shall in the coming days be accomplished here, to the glory, the reverence and the service of God.

Alpha and Omega. As we approach the Science Hall, you will see high on the South wall inlaid the Greek letters Alpha and Omega, symbol from time immemorial of the Triune Deity, the Beginning and the End of all; on the corresponding North wall are correlatively inscribed the Greek letters Chi Rho, age-old abbreviation of the name Christos, the incarnate Son of God, Anointed as Savior and Redeemer of mankind. By these and other symbols, Georgetown proudly and reverently professes her primary commitment to the worship of God in the Christian dispensation.

There is a particular fitness in the position of these emblems of faith on our science building. They are a manifestation of the high esteem in which we hold the pursuit of science in its most penetrating investigations, but at the same time a recognition of the limitations of science in the total view of man, of his nature, his purpose in being, his destiny. It is no new thing in the development of human life and knowledge—though assuredly it becomes increasingly ominous in critical times like ours—that there should be tension, antagonism, belligerence between such as would glorify, not to say deify science as the final source of wisdom concerning man and his problems, and those who would cravenly impede scientific investigation as a threat to anciently-held and sacredly cherished ideas. Too long in the recalling, too sad in the retelling, and too frightening in prospect, are the bitter, sometimes bloody battles between science and religion—perhaps more properly, between science and theology; between science and the metaphysics of philosophy; between science and humanism.

Each of the branches and pursuits of human knowledge needs all the others; each has much to say to the others, to complement each other in construction of the great mosaic of wisdom and truth, seen in its entirety only by the infinite eye of the All-encompassing Truth Himself, but to our finite minds, to our natures composite of matter and spirit, only partially attainable and piecemeal, through endless labor and patience and pain.

Our science building, I have said, is an expression of our faith in God, our gratitude to God, our dedication to the service of God. It is no less a manifestation of our faith in man, our gratitude to man, and our dedication to the service of man.

Faculty. But for all its majestic stature, for all its up-to-the-minute modernity, for all the care that has been expended in equipping it with the most advanced instruments of instruction and research, the building remains an inert and inanimate tool without the vivifying presence in it of a science faculty competent, outstanding and devoted to the ideal of realizing to the fullest the great potential provided, for the advancement not alone of science, but of students. We want, and I am happy to say we have, as the heads of our departments in mathematics and the sciences, men of vision, to administer and to direct our science course offerings and our projects in research to the best advantage; who will view their disciplines both in their own intrinsic values, and in their proportionate place in the total hierarchy of values. And we consider and accept in our instructional personnel only men of proved competence, of initiative and ambition; men fired with devoted zeal for the advancement of their particular fields of interest, and at the same time sympathetically attuned to the educational ideals and practices of Georgetown. To insure the best development of science education and research on all levels, an outstanding scientist has been appointed as special assistant to the president and board of directors to advise in this regard.

Interdisciplinary symbol. It is not merely a happy accident, but an external symbolic declaration of Georgetown's view of natural science in the formation and education of the entire man, that the site chosen for this building lies midway between our professional Medical Center and our undergraduate and graduate departments and schools of the sciences and liberal arts. It is not the result of chance, but of considered design that in this building itself the natural sciences and the life-sciences will work side by side in every degree, from the basic and fundamental principles imparted to neophytes, up to the investigative and contributory researches of the masters and the experts. Two predominant considerations arise from this circumstance, which I shall but briefly indicate, in the interests of your own forbearance, and in courteous deference to our distinguished principal speaker.

Speaking as an educator, and for an institution which is first and foremost an educational institution, Georgetown recognizes the validity and the value of that process, too long delayed, by which the natural sciences are breaking down the departmentalizing barriers and the exclusive interests of the disparate disciplines into a coordinated and cooperative system of functions and contributions to the teleology of all science—the understanding, the welfare, the progress and betterment of mankind.

Again, as educators, Georgetown is acutely conscious, in common with other universities, of the dilemma, the conflicting pressures, and the temptations arising from the legitimate and increasing need for trained personnel in the professions, in industry, in defense, and the primal commitment of the university to training and formation of educated men. It is a matter of delicate judgment and acute discernment to determine, in the total offerings of the university, the emphasis, the proportion, the balanced assignment of curricular time, effort and credit requirements to the broader elements of humanistic and liberal education, and the direct training of the student for a scientifically-implicated professional career.

To use, in summation, the recent words of Dr. Warren Weaver, whom I cite with admiration and gratitude for an inspiring statement: "Science is not technology, it is not gadgetry, it is not some mysterious cult, it is not a great mechanical monster. Science is an adventure of the human spirit. It is an essentially artistic enterprise, stimulated largely by curiosity, served largely by disciplined imagination, and based largely on faith in the reasonableness, order and beauty of the universe of which man is a part."

Guests. Something of the widespread implications, the manifold facets of science in our total life, are indicated in the distinguished men Georgetown is delighted to honor on this occasion. Each represents the highest achievements in some field or other of scientific endeavor and research; but each also signifies another aspect of science in its impact on our lives. The increasing involvement of science in our present day society, in our individual, sociological and national needs and activities, and by consequence, the concern of Government in the scientific climate and technological ferment, are recognized and honored in the person of the able and distinguished chairman of the Atomic Energy Commission, Dr. Glenn T. Seaborg. Dr. William O. Baker, vice-president for research in the Experimental Laboratories of the Bell Telephone Company, has made notable and significant contributions to the fields of science, engineering, technology, and to the welding of the resources of research and of industry for their mutual purposes, and for the common advantage of all our citizens.

In Dr. Willard Frank Libby we welcome a man known to all the world for the scientific works he has done, which have merited for him the highest honors and universal acclaim. As professor, and director of the Institute of Geophysics and Planetary Physics at the University of California, Los Angeles, he stands also as the representative of the place and the importance of science in university education.

So, to complete the cycle, may I repeat, as I began, that in these ceremonies of today, formally inaugurating our Raymond H. Reiss Science Building, Georgetown joyfully acknowledges her faith in God and her belief in the value of men; warmly acknowledges her debt of gratitude to the Divine Providence and to the generosity of her benefactors and co-workers; and loyally pledges herself to renewed effort and enlarged vision, in the service of God, through her dedicated service to mankind.

GEORGETOWN UNIVERSITY

SCIENCE AND THE HUMANITIES: UNITY IN DIVERSITY

GLENN T. SEABORG

The dedication of this new building devoted to the study of the sciences is yet another step in the long record of achievement of Georgetown University since its founding here in 1789 as a result of many years of planning and labor by Bishop John Carroll. From its beginning, there has been a strong tradition of the study of the natural sciences at this University. The astronomical observatory founded here in 1841 was the third observatory in the country at that time, and this was at a time when there were only 150 students here, including those attending the preparatory school. Even in those days it was a research observatory—for instance the first precise determination of the latitude and longitude of the city of Washington was made here between 1843 and 1847. Yet the observatory was also actively used for teaching, and continues to be so used to this day. In the early days of this University, the students held scientific exhibitions for their parents and the friends of the community; this was a sort of predecessor of our contemporary science fairs. In the 1890's, I am informed that there were more books on science cataloged in the University Library than in any other single category.

I should like to quote a small paragraph from the University catalog of 1893–1894, which best displays, I think, the attitude towards the sciences even this long ago:

"Whatever is important in natural science is made a part of the curriculum, and is taught with a philosophical analysis intended to guard the student against that confounding of mere information with learning which is the danger of modern education. Physics, mechanics, geology, general and analytical chemistry, all form important parts of the regular obligatory series of studies.

"It is believed that this course is calculated to develop and train all the powers of the mind, rendering it capable of understanding and appreciating all branches of learning. It serves as a foundation for special training in any branch that the student, with his mind mature and trained, may decide to take up."

The basic patterns and attitudes of American education have evolved and broadened and deepened over the years; and the basic ideals of George-

---

This address was delivered at the dedication of the new science building at Georgetown University, October 13, 1962.

town University in the 90's may also be found in many other places today. For instance, a few years ago, President Conant of Harvard appointed a committee to survey the problems of general education in the United States and in Harvard; in 1945, they issued what has become known as "The Harvard Report on General Education," which in many ways sounds like a paraphrase of much of the 1893 catalog. The Harvard report says, among other things, "The true task of education is therefore so to reconcile the sense of pattern and direction deriving from heritage with the sense of experiment and innovation deriving from science that they may exist fruitfully together, as in varying degrees they have never ceased to do throughout Western history." These aims of intellectual unity remain all-important in our increasingly complex world. Let us consider some of the ways in which we shall be able to attain them.

Symbol of unity. This building, serving as it does to bring together the sciences of chemistry, physics, biology and mathematics, and being closely related to the department of astronomy, serves to symbolize the unity of the sciences. In the same way, the central location of the building, easily available and accessible to the Medical, Dental and Nursing Schools, the School of Foreign Service, and the Institute of Languages and Linguistics, symbolizes the close interaction and interdependence of the sciences with these other fields of learning essential to our culture and well-being.

One of the central problems of our complex world today consists of using wisely the accumulated knowledge discovered in each separate area of thought. Because of our rapid growth of learning in nearly every field what we know about almost anything—linguistics, nuclear structure, medieval history—has essentially doubled in our own lifetimes, and may be expected to continue growing during the lives of the students who will be entering this building.

There are great opportunities for cross-fertilization between disciplines at a university of this sort, where learned men in many areas of thought breathe the same air of free and devoted inquiry. It is going to be increasingly important to our world to have men from different fields talking to each other. It is good to know that this sort of intellectual exchange has been going on—and successfully—here at Georgetown.

Interdisciplinary programs at Georgetown. I should like to discuss some examples of concerted action between disciplines that has been going on at Georgetown and elsewhere, which result in the extension of our understanding of medical problems, more information on human behavior, and a deeper knowledge of our cultural history. One cannot help being impressed with the wealth of opportunity for the enrichment of our lives that can result from the multidisciplinary approach to scholarship.

I understand the department of astronomy has a small computer which is normally used to analyze data on the composition of stars and the planets but which has also been used successfully for psychiatrists at a local hospital to make a comprehensive survey of possible factors in the origin and behavior of several score schizophrenics. I remember that our word *lunatic* comes from the Latin word meaning moon, so perhaps there is some sort of ancient precedent for such psychological-astronomical study here.

There is a very interesting program here at Georgetown on the use of computers for automatic machine translation of foreign languages. In addition to its obviously highly practical applications, such a program also has a profound intellectual basis, since the structure of languages is much more complex than we might think. Although a child of four may talk fluently, a linguist can spend the rest of his life understanding the subtle relationships between various languages. We all know that a worker is no better than his tools. Words and language are our tools of thought and the better we can understand them through the efforts of our linguistic scholar, the better equipped we are for clear and precise thinking.

In the fields of sociology and economics here at Georgetown, important studies are being carried out with the aid of computers on the problems of the voting habits and patterns of behavior of citizens in relationship to their cultural and economic background.

I understand there has even been a study made here by the mathematics department in a labor-manangement dispute about the most effective way to distribute bottles of milk over a large area to the front door of the housewife. This may sound like a small matter, but after all it is a specific example of the problems of production, distribution, and consumption which are significant to the individual who wants fresh cream in his coffee each morning, to the dairy farmer, the distributor, and to those who are responsible for a proper balance of agricultural production in the country.

Research has been carried out here on the way blood flows through the human circulatory system. This highly complex and dynamic system is being investigated by the combined modern tools of mathematics, physics, theoretical hydrodynamics, chemistry, biochemistry, medicine, and physiology.

I understand there are students here from Iran who are studying astronomy, and some day there may be an observatory in that country which, in its way, will be an intellectual extension of this school.

These are all excellent and meritorious pursuits for a university, and certainly they are in the best of both ancient and modern tradition. Many people think of the new and exciting frontiers in science as being thousands of miles out in space, down at the bottom of the sea, at the end of a billion-volt accelerator, or in an electron microscope that probes the mysteries of the living cell.

Other examples. We should remember that frontiers are not only at the edge of the unknown intellectual wilderness but also between already-developed areas of knowledge. And today, these in-between areas can be very exciting indeed. Many contributions can be made in many unexpected ways by such interactions. For example, let us consider other examples of opportunities for discovery when science is used as a tool to help us understand history, or art, or the development of thought.

Sybaris. There is a word, "sybaritic," in our language used to describe the ultimate in luxury and wealth. It refers to the actual way of life of the Greek Colony of Sybaris in Southern Italy, probably the wealthiest city of the world in the sixth century before Christ. Naturally such a city would gain the jealousy and envy of its greedy neighbors. Sybaris had to defend itself from its neighbors in numerous battles. But the people of Sybaris were delighted by the luxuries and playthings of their affluent society—in times of peace, they even taught the horses they used in battle how to dance to music. We are told that their neighbors from Crotona finally overcame them in a battle in 510 B.C., using a unique secret weapon. They brought out a band which played the same pieces of music to which the horses had been trained; the horses started dancing, and the victorious soldiers of Crotona slaughtered their helpless riders. The city of Sybaris was razed to the ground, and the Crotoniats diverted the river Crati over its ruins. Only traces of the old city could be found by Herodotus less than a hundred years later, and its exact location and extent have by now completely disappeared from the memory and record of man.

Yet today, there are new and more powerful tools available for the scientist-historian to investigate what lies beneath the surface of the earth. We now know that the tiny nucleus of the hydrogen atom is both a kind of spinning gyroscope and a tiny magnet. It is possible to use these properties of the nucleus to build a highly sensitive device to measure local magnetism to one part in 100,000. Ancient tombs deep under the ground, or fireplaces or buried walls, each subtly disturb the earth's natural magnetic field; and the experienced physicist-archeologist can use this information to help locate these buried articles of irreplaceable value. An international group of scientists from the United States and Italy has been using this and other techniques to investigate the ancient valley of the Crati river. In just a few days time they outlined half a mile of one of the ancient walls of the city of Sybaris. The sensitivity of the method may be judged by the fact that most of the wall was buried beneath about ten feet of the accumulated silt of the centuries.

Babylon. In the Near East, the ancient Babylonians were great believers in the importance of omens and astrological phenomena, which they carefully recorded on clay tablets we can dig up today, over 2,500 years later. These tablets were a sort of continuing newspaper of the day, since all sorts of information was included in the records—the positions of the moon and planets in the sky, the name of the king, the market price of barley, oil, dates and wool, weather conditions, floods, droughts, epidemics, invasions, and so on. Only recently, scientists have used modern electronic computers to calculate the day-to-day positions of the moon and planets in the Babylonian skies for some 600 years preceding the birth of Christ. Now the archeologist can read the positions of the planets as recorded on the tablets they discover, and by looking up the corresponding planetary arrangements in their retroactive almanac, they can give the tablet an exact date.

Perhaps this research may seem remote and unimportant to some of you; but it might be interesting, for example, for someone in the field of economics to study the long-term fluctuations of the recorded commodity prices in ancient Babylon, as influenced by the other recorded factors of weather, invasions, wars, and diseases. There are six hundred years of data waiting here for the thoughtful student to investigate.

Archimedes. Let us look at another aspect of history. Archimedes certainly had one of the greatest minds of antiquity, making innumerable contributions to the then newly-budding sciences of mathematics and engineering. Considering himself primarily a philosopher, he disdained making practical applications of many of his inventions, thinking this beneath the dignity of pure science. Yet when his native city of Syracuse in Sicily was besieged by the Romans, he was called upon by King Hieron to help in the city's defense. We hear a great deal today about how essential it is to our national defense that we maintain a vigorous position in science and technology, and I think that it is interesting to note that this same kind of recognition had taken place nearly twenty-two centuries ago. You can read in the history books of how Archimedes' ingenious war machines helped protect his city for nearly three years of siege. But one night in 212 B.C., while the defenders were celebrating a great feast to Artemis, the Roman Marcellus forced open one of the gates, and the city fell. A Roman soldier killed Archimedes while he was studying a problem in geometry. This is all an old and familiar story, of course. But the final chapter has not yet been written.

Sonar at Syracuse. Now, we have all heard of sonar—a method by which sound waves passing through water bounce back and are detected and measured. The captain of a ship can use this principle to measure the depth of the water he is sailing in, or to locate dangerous rocks, submarines or other nearby ships. Recently, engineers succeeded in developing a new kind of sonar which will penetrate down many feet into the mud and ooze of the ocean floor. Such a device can be used by engineers to study sedimentation in rivers, or by the Navy to locate lost torpedoes; but there is a particularly interesting new application of it at this moment in under-water archeology. A group of scientists are now using this device in the harbor of ancient Syracuse to locate the relics of ancient Roman ships, which have been lying there buried beneath the mud for thousands of years.

Some of these ships they are finding may have been among those very ones which were sunk by the war machines of Archimedes which were so terrifying to the Romans. It should be fascinating to follow the discoveries which will be made in this way at the bottom of the Mediterranean. Underwater exploration with the aid of the aqualung and other modern inventions is continuing to enrich enormously our understanding of the past 3,000 years of history in much of that part of the world.

Archeology. Other related investigations are also going on in Italy. For example, we know very little about the Etruscans, the first inhabitants of the Peninsula. Their language and whole way of life is still very much of a mystery. The many tombs they left scattered over the north of Italy are being investigated carefully today—being located from the air by means of color and infrared photography and on the ground by magnetic and electrical measurements. Then an ingenious high-speed portable drill is put into action, penetrating deep down into the tomb. The scientist next drops a tiny periscope or micro-camera down the drill hole, and can see if the tomb has already been robbed of its wealth, or if it contains certain objects that make an excavation worthwhile. Just recently, a television camera was hooked up to such a periscope permitting people all over Italy to see the magnificent art of their ancestors who lived even before the legendary Romulus and Remus established the city of Rome.

By these new methods, archeology has almost been turned into a mass-production operation, since it is now possible to locate and explore five or six Etruscan tombs in a single day. This would have been impossible by the old pick-and-shovel techniques. It is curious that one of the drills being used to explore our ancient past was originally developed in connection with the space research program—for possible sampling of the surface of the moon!

Today's archeologist is in a race against many competitors. In Egypt, as we know, the waters of the Aswan Dam are threatening to cover up the great temples along the upper waters of the Nile. In other parts of the world, modern tractors and bulldozers are burying or destroying ancient records of the past. Modern grave robbers and antiquity smugglers are finding the private sale of souvenirs of the past to be a profitable business; but it is one which may destroy unique clues to our historical heritage. So the new scientific tools of detection and investigation are serving to make the life of the dedicated archeologist a little easier, by giving him the tools necessary to help him locate the most important and significant places to investigate.

Computers and St. Thomas. Let us turn to other fields. There may seem to be little, if any, connection between theology and the intricacies of the modern high-speed electric computer. Yet the computer is beginning to make its contributions to this complex and subtle field of thought. The complete works of St. Thomas Aquinas include approximately 13 million words. A complete concordance or index to the words in all his books would be of great use to those who would like to make a detailed study of the way he thought and wrote, or of how his thinking may have been influenced by others of his time and before. It has been estimated that such a complete concordance would take 50 scholars some 40 years to complete by hand in the old traditional way.

By the use of the newer machine-processing of such data, such a concordance could be completed with about one-fortieth of the time and effort, permitting the researchers to use more of their time for their specific scholarly abilities, such as interpreting and organizing the information obtained. Such a program is currently under way—a library in Italy has recently put all the words in the *Summa Theologica* of St. Thomas Aquinas on some 1,600,000 punched cards for machine processing.

A similar program is under way to study the words of the famous Dead Sea Scrolls; it is interesting to note in this instance that a special card punch had to be devised to punch the cards from right-to-left, since this is the way the Scrolls were written.

The lesson. Perhaps the lesson to be gained from this account is the fact that there is a unity of knowledge and knowledge-seeking. There is a continuum that extends from theories of the origin of the universe through the rise of life on earth to the evolution and history of man, and on to the completion of the cycle with such abstruse fields as high energy particle theory. There is no knowledge that is isolated from the total fabric.

It is characteristic, I think, that today at this University, students who will be entering the world of business and the foreign service are required to take courses in science as part of their intellectual training. This is but a reflection of the fact that science and technology are integral and inseparable parts of world affairs and will continue to be in the future.

Georgetown University is also performing many other services for the community—both for the Washington area and for the country as a whole. Each year, many local high school teachers come here to learn the latest advances in biology, in physics and in mathematics. Members of the faculty here are very active in advising the local schools on how to incorporate the new sciences into their ever-expanding curricula. Local high school students are able to get their first taste of real scientific research, by working here in the observatory and laboratories.

At another level, Georgetown is, as you know, helping to train members of the Peace Corps who will be going to the once-remote corners of the world. Ethiopia and Afghanistan may seem of little consequence to many of us in our day-to-day life. However, members of the Peace Corps studying here today will soon be going to those far corners of the world to teach mathematics and physics and biology in the high schools. They are part of a group of dedicated young people who are going to try to bring learning to strange places. What is learned in this building will reach to the far corners of the world and we hope the effort will help in what H. G. Wells once called "the race between education and catastrophe."

Georgetown, of course, is well known for its many contributions to the Federal government. A very substantial part of its graduate students are people who are also working here in Washington in the Federal offices and laboratories, and it may be expected that these new facilities will facilitate this essential contribution in the future.

Georgetown has long been a vital part of the local intellectual community as well—for instance there is a substantial amount of cooperation between this University and the other colleges and universities of the area. Students and professors attend lectures and seminars in other schools: libraries cooperate in the matter of interchange of books and journals—to a certain extent, it can be considered as part of an informal University of Greater Washington—and this sort of cooperation can only help to increase the vitality of our intellectual community by giving variety in approach and strength in diversity.

Perhaps these examples will suffice to show that Georgetown University has long served as an active and essential part of the intellectual, local and national community. With the advantages of the fine new facilities of this building, it may be expected to contribute even more in the future in all of these fields. I like to think that there are many new and exciting things to be done here, and I am sure that this building may serve as a kind of focal point for many of them. Shall we perhaps see the students in law learning to use computers to help locate legal precedents for their cases? Will historians, philosophers, and archeologists consult with the physicists and chemists to help establish the validity of their conclusions and to discover new historical relationships?

There are many opportunities here for the scholars of tomorrow—and I mean scholars in the broad sense, whether an undergraduate carrying out his first small piece of original research, or the senior professor continuing many years of earnest investigation. In any case, we can look forward to many more fine things from the men and women of Georgetown, as a reflection of the fundamental philosophy of your school.

This is marked by your continued emphasis on service to the community as an expression of Christian democratic ideals, preserving the best of the values of the past and adding the best of the values of the present.

You will continue to try to create a unity from the intellectual tools of the medieval trivium which contained logic, grammar, and rhetoric. The world continues to be in vital need of men and women trained in the arts of precise thinking, critical reading, and clear expression.

To these we must add the best of the contemporary scholarly disciplines of the sciences, the arts, the law, and the other fields of study offered here, and the graduates of this University will continue to be able to bear their full share of responsibility to their community, their nation, and the world.

We are here today to dedicate this building; yet the real dedication, I feel, is being made by the teachers who will be working in it, teaching in it, and doing research within these walls. It is only their dedication to learning which makes this building more than a warehouse of books and apparatus. It is this dedication which will inevitably carry over to their students who will go forth to make the world a better place to live in.

United States Atomic Energy Commission

SCIENCE AND THE SOCIETY OF JESUS

JOHN M. DALEY, S.J.

During my years as a student and later as teacher at Georgetown University I joined with many others who often looked forward to this day. The need for this building has long been with us; the hope for its realization has too, too long been frustrated. You can well imagine, then, the delight with which I am present today, and with what sense of privilege I have blessed this new Science Center so significantly situated at the heart of the campus.

Whatever I might say today would be poorly said if it were not prefaced by a word of sincere congratulations. Yet, where do I begin? Beyond any question commendation is due to Reverend Father President. And such praise is freely given. Still, what of the host of hidden helpers who gave of their time and substance that this monument to the past history of Georgetown and this testament to its hopes and academic aspirations might rise before us today? I can only say to these: Well done! You shall be named and honored only at that last Convocation where every achievement is noted.

It is indeed eminently proper that a university such as Georgetown should possess such a scientific center as this. Science is no stranger on this campus, as it has been no stranger on the campus of any Jesuit university.

Jesuit scientists. As early as the 16th century the Society of Jesus can be found contributing to the field of scientific quest and discovery. Father Christopher Clavius, mathematician and astronomer, is credited with the reform of the calendar under Pope Gregory.

The work of Father Ricci in China is known to all students of the history of Science. And Father Athanasius Kircher is celebrated for his versatility in the natural sciences. The field of his interests included hieroglyphics, the invention of a counting machine, the speaking tube and the magic-lantern. No small achievements these—and in the 17th century!

Father Francesco Lana of the Society of Jesus was the scientific founder of aeronautics. Father Boscovich drew the plans for the correction of the cracking of the great dome of St. Peter's in Rome. Father Morcelli Stefana has been called the founder of archeology.

In the area of Entomology there was Father Eric Wassmann; in Botany, Father Von Schrank was held a scholar and pioneer. Fathers Algue and

---

This was the third of the addresses delivered at the dedication of the new science building at Georgetown University, October 13, 1962.

Ghezzi achieved no little recognition in the science of meteorology. Their prediction of typhoons saved thousands of lives and millions of dollars' worth of property. Father Algue invented the barocyclonometer, an instrument for the detection of typhoons which was once part of the equipment of American battleships.

In Physics, Father Braun of Bohemia won world-wide recognition for his invention of the torsion balance used in measuring the gravitational pull of the earth, while Father LeJay earned high place among physicists for his investigation of magnetic and gravitational phenomena and for his invention of the LeJay pendulum. These among many others have been noted.

Closer to home, Georgetown herself has gloried in her sons who have labored in the field of the Sciences.

Father Angelo Secchi began his work in Astronomy at Georgetown, and later moved to Rome where he became director of the Jesuit observatory. At his death he was considered one of the most famous astronomers and men of Science in the world—a true authority on the Physics of the Sun.

Father Benedict Sestini, who was the architect of St. Aloysius Church across town, labored at Georgetown and Woodstock College. His book on calculus was used at Yale College.

Father James Curley, who had been the teacher of Father Secchi, is greatly responsible for the Georgetown Observatory.

Anyone familiar with the history of Georgetown knows these are but some of the names of the men who became noted in the field of science.

There are of course many others. Some still live and labor at Georgetown. Their joy must be supreme today as they behold this new Center of Science. Yes, it is right and proper that the sciences be given such a setting for their development and growth on this Jesuit Campus.

Father John Grassi, the second Founder of Georgetown, made use of his attainments in the field of science much as he had wished he might have done at the imperial court of China. He had been destined to follow in the footsteps of Father Ricci in China but passage there was denied to him. Here at Georgetown in 1813 he had one of the Jesuit Brothers construct out of wood, since the College at the time could not afford to supply brass for their construction, a number of mechanical devices for illustrating the Copernican system, the motion of the planets, the annual and diurnal movements of the earth, the succession of the seasons, and light phenomena. He is said to have fashioned a globe and geometrical figures, composed a dialogue on the Copernican system which the students recited very successfully at a public function, and finally fitted up a museum in which he displayed his home-made apparatus, together with the optical and astronomical instruments which he had brought with him from Europe.

Although it is a long cry from this building to Father Grassi speaking to the Jesuit Brother carpenter and asking him to make little models which might be used in his Science lectures, there is one thing completely the same. And this must not be overlooked. Otherwise this magnificent building stands as a mockery.

Ends and means. Father Grassi's little models and this immense multimillion dollar structure are the same thing. They are tools. They are instruments to be used for the quest of truth—God's truth—for its study and its propagation. All who use this must keep this fact in mind, otherwise they misuse this that has been given to them. The Faculty, students, researchers and co-workers must never think or act as if this Science Center or its functions are an end in themselves.

The search for truth is an exhilarating experience, for it has as its summit all truth, namely God. The life of a Scientist is a glorious life, but it is a life fraught with peril. As he unlocks the secrets of nature which have been hidden from the beginning, and which are not really new, the Scientist can become so intoxicated with the beauty of what he has found, and the promise of what yet lies in wait for his touch, that erroneously he might believe these things are of his making. Tragically he could fail to relate the fruit of his discipline with the results of the other fields of knowledge, and thus isolate himself from truth itself.

In a speech given some years ago which he entitled "The Obligations of the Scientist," Mr. John McCloy recalled to his audience that "just after the first sputnik went up, and so much emphasis was being placed on the need for experts, President Eisenhower in the midst of all his problems, said that he would gladly trade a dozen of the finest engineers and scientists, precious and rare as they are, for just one thoroughly reliable moral philosopher. What is the right thing to do," continued Mr. McCloy, "may be more important to determine than the means by which it is to be done."

This morning then, in having had the privilege to bless this building, I add a request to have one further privilege. Let it be my privilege to pray and ask of you who shall use it that it be used well. Let truth be sought unceasingly, but let it be sought in its fullness. Let those who use it, ever realize that what they shall find—no matter how important their finding may be—be but one pebble in a grand mosaic. Let them be able to search their minds, to live in great humility, and to realize that the truth they have must be placed in relation to the other truths of God's creation. It is then that they will be able to stand on the threshold of true wisdom.

PROVINCIAL'S OFFICE, BALTIMORE, MARYLAND

THE JESUIT AS PRIEST-SCIENTIST

WILLIAM W. MEISSNER, S.J.

The Jesuit in our time who is professionally engaged in scientific activity seems to have been caught up in a dichotomy of his religious and scientific activities. The dichotomy is experienced by many in the mature years of their apostolic lives, and it is felt with increasing intensity by those who are currently engaged in forming themselves to fulfill the difficult role of the Jesuit-scientist. The theme is recurrent at conventions and in recreation rooms.

The conflict, I will suggest, is basically a false one and it involves a fundamental conflict of roles. The Jesuit scientist has adopted two roles, that of the priest and that of the scientist, which present themselves as dichotomous and exclusive. For various reasons, historical and psychological, these roles have been kept in isolation. The Jesuit conceives of his priestly activity as forming a different frame of reference from that of his scientific activity. Consequently, the priest-scientist lives with a double image of himself. I would like to suggest that this schizoid condition is in itself undesirable, as well as inadequate to the realities of our contemporary situation.

However undesirable such duality may be, it is a fact of our experience, and its implications are more or less acute. Life depends upon the integrity and organization of the vital organism. If we destroy the one, we lose the other. In a sense, religious life demands a certain underlying organization of that life. The result is told in terms of conflict, frustration, insecurity and anxiety.

Resolving the conflict. We recognize the value of science, but what we do not recognize is how the values of science can be integrated with the values of the Jesuit life. If there is to be any resolution of this conflict at all, it must come primarily through the composition of these disparate roles into some sort of unity. We must somehow try to define a role which synthesizes the functions of priest and scientist. The definition is not easy. Like any true synthesis, the synthesis of roles is ultimately a matter of activity in the concrete, existential order. Consequently, it is best spelled out in concrete terms, concrete situations, concrete actions. Definition, however, is of the abstract order. We run the risk, then, of juxtaposing in the mind's eye thesis and antithesis without ever really bringing into focus that which is essential to real synthesis. We would be left with a juxtaposition of opposites—more sustainable, perhaps, because held at a distance by abstraction, but hardly more helpful than the existing conflict.

The unified role is somehow a conjunction of the conflicting roles of priest and scientist. Projected into the realm of action, the activity of the priest-scientist is at once priestly and scientific. Although he participates actively and fully in the functions proper to the scientific community of which he is a member, his participation is not merely scientific. As a priest-scientist, his participation is somehow fuller. This does not imply in any sense that his participation is non-scientific. If it were non-scientific, he would not really be a member of the scientific community at all. Obviously, if his participation is scientific, he is accepted into the scientific community on the basis of his scientific credentials. The role of priest-scientist demands that these credentials be of the highest possible order. At the same time, while his participation is eminently scientific, it is more than that.

It is not a simple matter to spell out this "more." The priest-scientist is primarily priest. In his participation in the activity of the scientific community, the priest-scientist is exercising a specifically religious function. The function is apostolic; it is also symbolic. It is apostolic insofar as he comes as one who bears testimony to the truth. That testimony is only occasionally verbal, but it is always real in so far as he bears in his person a living incarnation of religious truth. His participation is likewise symbolic. He embodies the fullness of the Christian religious life, joined to the ideals of dedication and competence which constitute the scientific prototype. He symbolizes, then, the unification in truth of religious and scientific knowledge, of faith and reason, of Catholic wisdom and secular learning, of the Church and modern science. Perhaps we can say that this role is fundamentally prophetic—he is the interpreter of religious truth, creating, as a kind of atmosphere within which scientific investigation finds its true orientation and justification, a consciousness of God's salvific action and the intimate internal relationship between the dispensations of men under divine Wisdom and the broadest and deepest implications of the scientific inquiry.

The Jesuit "proposition." Such a role is eminently in keeping with the Jesuit "proposition." It is an existential synthesis of the religious and the priestly with the intellectual and the profane. As such, it is a reflection of the structure of the Society herself. She is compounded of the divine and the human. What is of divine inspiration in her, is immutable and perpetual—as immutable and perpetual as the divine truths upon which she rests. But that divine element was marvelously fashioned through the genius of Ignatius into a highly flexible and adaptable instrument of the divine purpose, an instrument whose disparate elements are fused in a unique existential synthesis. The synthetic composition of the Society participates to that extent in the synthetic character of the Church, which is immutable and infallible because divine, and flexible and adaptable because human. And the Church herself is but a reflection and participation in Christ Who is her head, for He was also compounded of the divine and the human. As God He was eternal and immutable; as man, He suffered and died.

When Ignatius composed the Tenth Part of the *Constitutions,* he set down in two separate paragraphs the general means by which the ends of the Society were to be sought. He first set down the supernatural means which govern the quest of perfection—"*probitas et virtus, ac praecipue caritas, et pura intentio divini servitii, et familiaritas cum Deo in spiritualibus devotionis exercitiis, et zelus sincerus animarum ad gloriam Ejus qui eas creavit ac redemit, quovis alio emolumento posthabito.*" (*Const.* X, 2, 813) Then he added the natural means—"*doctrina exacta et solida, et modus eam proponendi populo in contionibus et lectionibus, et forma agendi cum hominibus eosdemque tractandi.*" (*Const.* X, 3, 814) It is inconceivable that the two facets which Ignatius thus spells out should be conceived of in any fashion but that of complementarity; certainly, they should not be regarded as conflicting. But the complementarity has a special impact in that both sets of means are essential to the functioning of the priest-scientist. Without the former, the effectiveness of his priestly function is diminished; without the latter, his total effectiveness as priest-scientist is erased.

This last point deserves elaboration, since it is central to the specific conflicts confronting the Jesuit scientist. I would like to consider it under two separate headings: the quest for perfection, and then, sacred and secular learning.

Quest for perfection. Perfection is the basic objective and purpose of our religious life. The *via perfectionis* is spelled out for the Jesuit in the *Constitutions* of the Society. The section "*De Labore Scientifico*" in the seventh part of the *Epitome* lays down highly significant directives. Scientific work, including work in the profane sciences which we are now considering, is to be regarded as among the primary and most necessary ministries of the Society (*Epit.* VII, 685a). The letter of our present Father General on the ministries has elaborated this point in great detail. This work is so important that provincials are not to permit other demands and needs of their provinces to take precedence over the application of qualified men to scientific work. Moreover, this designation is to be both definitive and exclusive (*Epit.* VII, 685a, 2.). Further, superiors are to see to it that those who are engaged in such scientific endeavor are provided with the time and whatever equipment may be required for them to dedicate themselves to scientific inquiry (*Epit.* VII, 685a, 3.). This much is prescribed for superiors. The last section sets forth an important prescription for subjects who have been designated for scientific work. They are not to be misled by the false opinion that they will be able to serve God better by engaging in other activities which are more properly apostolic or priestly. But " . . . *cum sincera intentione divini servitii, labori scientifico, qui quodammodo totum hominem requirit, forti atque abnegato animo, omnes suas vires omneque studium applicent, atque adeo totam vitam suam in hoc holocaustum Divinae Majestati offerant.*" (*Epit.* VII, 685a, 4.)

Thus is succinctly stated the norm of perfection which the Jesuit scientist is to follow. It is an ideal which incorporates the noblest objectives of both the religious life and the scientific life. No one will question that it represents an ascetic ideal which is demanding and difficult to achieve. The difficulties are constantly mounting with the increasing demands created by the rapid progress of science on all of its many fronts. There is no field of modern scientific inquiry which does not demand total dedication and engagement of those who ambition high proficiency and productivity within it. Real proficiency calls for a single-mindedness and a purposefulness which gladly offer the sacrifice of time, recreation, sleep, and a whole host of more congenial pursuits.

The asceticism of the scientific vocation is not merely a matter of the sacrifice of more leisurely and graceful pursuits. The enterprise itself constitutes a discipline of mind and spirit. The true scientist, the competent scientist, is a man who has grown to a realization of the limits of his knowledge and capacity. He is aware of the extent to which the little sure knowledge he possesses is the product of other and better minds, and that he himself is an almost insignificant participant in a great human enterprise. This "scientific humility" is a common possession of the scientific community, but it has specific overtones and reverberations in the life of the Jesuit. There are borne in on him the constant realization and wonder at the majesty and power of the Creator Who fashioned the reality which so perplexes and confounds our attempts to understand, and at the same time, a deep admiration of the human spirit which struggles on with courage and determination against almost insuperable difficulties, seeking to learn, understand, and penetrate the mysteries of God's creation. How simply all of this is elevated to the supernatural and suffused with grace by a pure intention and a heart which seeks in all this to follow Christ and seek out the greater praise, reverence and service of the Divine Majesty.

Sacred and secular learning. But I must not forget my second heading: sacred and secular learning in the life of the Jesuit priest-scientist. There does not seem to be any real difficulty in understanding the function of scientific training in the preparation of the Jesuit scientist; this is generally admitted. The difficulty asserts itself rather in understanding the function of the traditional seminary disciplines in the role of the priest-scientist. I have no difficulty in perceiving the function of the priest-scientist primarily in intellectual terms. The question, then, is rather what kind of intellectual function is proper to his unique role. From the very manner in which I state the case, it is apparent that I already have an answer in mind—if the Jesuit scientist is to fulfill a unique role, it will have to serve a function which is more complex than that of the scientist or that of the priest.

Personal sanctity. As a guiding norm for trying to come to some formulation of the true function of the Jesuit scientist, it is imperative to remember that there is a hierarchy of values in our lives. The religious ideal of personal sancity is what governs our lives and provides their fundamental dynamism. It is that which substantiates and energizes our religious profession with its attendant vows, our priesthood, and whatever else is to be included in the formal structure of our lives. From a purely personal point of view, it is somehow psychologically out of joint, and perhaps a little naive, to think that one could expect intelligent men, who are committed to enterprises of great intelligence, to live this kind of religious ideal in a simple, untutored, unreflexive and unreflective spirit of child-like faith. That certainly was not the spirituality of Ignatius—he at least was perceptive enough to recognize that his men had need of solid formation, particularly if the apostolic works they undertook were of a high intellectual order. Jesuit spirituality, if it is to be lived and effective, demands the foundation of solid theological training and must be nourished by the continual and ever more penetrating assimilation of the word of God. That assimilation must be intelligent, deeply reflexive, informed, vital and theologically secure. Some of the deepest problems, which arise to challenge the faith of intelligent and intellectual Christians, stem from the advance of modern science. They are serious problems and not all of them have been brought to solution. The Jesuit, therefore, needs the security of a maturely reasoned and theologically informed faith if he is going to take himself seriously as a Jesuit and as a scientist.

Apostolic purpose. From another point of view—a more social one—the primacy of the religious dynamism in our lives means that our scientific endeavour must be apostolic. It is set down in the opening phrases of our *Constitutions* that the *finis Societatis* is the salvation and perfection of our own souls and the salvation and perfection of the souls of other men. This is the end which is to determine and specify all our undertakings, and it is in this sense, as ordered to the salvation of our neighbor, that our scientific endeavour must be apostolic.

One of the last and minimal elements in the concept of apostolic purpose is the conversion of individual scientists. Individual conversion is perhaps a by-product, an offshoot of our effort, produced by God's grace in His own good time. However, it can hardly be considered as an adequate reason for Jesuit engagement in scientific work. But what, then, should apostolic purpose mean? The answer to this question would have to be very complex, but I should like to indicate briefly two aspects of it which seem to me to be essential. First, scientific activity is for us basically Incarnational, in the same sense in which all the external works of the Society can be said to be Incarnational. We carry on and extend, in ever new contexts of human existence and experience, in constantly changing and multiple cultural milieus, in a constantly renewed and revitalized effort in space and time, the basic function of the presence of the Incarnate Word among men—the sanctification and supernaturalization of human activity. But such an effort cannot be projected on a purely objective level, as if one were to claim that objective membership in the Mystical Body is the sufficient condition for its realization. The effort is personally involving in the subjective order—my proximity of union with Christ as an *instrumentum conjunctum*, the degree to which, in the authentically Pauline sense, I am in Christ and Christ is in me, determines the extent to which the Incarnational objective is to be fulfilled by and through me. It is at this point that the gift of the priesthood and Jesuit scientific activity enjoy a common purpose, so that it becomes a distortion of that common objective and a falsification of the real structure of our religious and spiritual lives to disengage the priestly function of saying Mass from the scientific functions which fill the rest of the day. Separation in time and place should not be mistaken for disjunction in ultimate purpose.

At another level, which is also very broad, although subordinate to the Incarnational objective, apostolic purpose involves a certain cultural impact. There can be little doubt that modern science constitutes a highly significant, in fact dominant, influence on modern culture. That would not be such a distressing state of affairs, if it were not for the fact that the historical development of the scientific movement became entangled in a certain system of values which must be described as naturalistic or secularistic. Unfortunately, the historical precedents are all too clearly drawn for the revolt of science against religion—Galileo, Darwinism in biology, Freudianism in psychology, etc. If it were only a matter of revolt the effects would not have been so tragic or have had such profound consequences. But it is also a matter of rejection of religious values. Consequently, the scientific movement and the scientific mentality flourish in a cultural milieu which is isolated from the traditional values of a Christian culture. If we are realistic, we recognize that even in the sophistication of the twentieth century the basic attitudes which generated the original crisis of revolt and rejection are still at work in both the scientific and religious communities. There is a tremendous work of religious culture to be done whose implications look far beyond the small segment of the general community which constitutes the scientific subculture. It can be accomplished by planting the best yeast in the dough and permitting it to ferment the entire mass. It can be accomplished by vital leadership within the scientific community, by the testimony of dedicated lives, by the present and lived reality within the scientific community of men who are dedicated to the highest religious ideals and who live them intelligently and maturely without the slightest detriment to their scientific effectiveness.

Dynamic synthesis. What is required, then, in the order of concrete activity is a dynamic synthesis of religious life and scientific work. The Jesuit scientist must effect an *unio oppositorum*—he must become in an authentic sense a man of God and a man of science. He does this by living at the highest level of function the fullness of his priestly and religious life and the fullness of his scientific life. But this type of dynamic synthesis is not strange to our Society; it is, in fact, part of the essence of our life. Was it not the genius of Ignatius to be able to synthesize the extremes of the life of contemplation and of the life of apostolic activity, and thereby create a new and more effective instrument to meet the needs of the Church in its hour of greatest need? But the role and the function had first to be formulated. Similarly, the conflict of roles with which we have been dealing here, can be resolved only when we have been able to formulate to ourselves the composite image. This is true on the institutional level where decisions of policy and objective are decided in terms of that image; it is true secondarily in the lives of individual Jesuits who commit themselves to this undertaking.

From a slightly different point of view, what is at stake in all this is the formation of a sense of identity for the person of the Jesuit scientist. The person who has achieved a sense of identity as a priest and as a scientist will be able to fulfill the demands and expectations of that complex role with facility and intelligence. Identity formation is, however, a complex process. It demands a mature personality for complete success. Psychologically—simplifying in order to focus on an essential part of the process—such an identity is formed by the internalization of certain attitudes, values, convictions, habits, knowledge, etc. In the formation of such an identity, then, the image must somehow be projected in order that some sort of internalization can take place. This is an essential part, for instance, of professional training: the trainee is placed in a professional atmosphere and is able to assimilate the image of the professional man projected by his mentors. This element is missing in the formation of the Jesuit scientist, although there is no necessary reason why it should be. As it is, his religious and priestly training is conducted in circumstances and under mentors who provide a certain image of the priestly life. His scientific training takes place under completely different circumstances and under different men, who project a completely different image of the man of science. The trainee is striving to internalize both of these images, and in so far as he lacks a composite image with which he can identify, he internalizes these images disparately with the result that his own identity as a Jesuit scientist is fragmented. This is neither a healthy nor a desirable situation.

Problems. How this situation is to be resolved is a practical question of considerable difficulty. We have already seen that its resolution is not only possible but eminently in tune with the highest ideals of the Society. But serious difficulties must be worked through in order to achieve the necessary adaptation in this area. One problem is that commitment to the work of science carries with it a definitive orientation of one's religious life in the direction of apostolic activity in a way which is more decisive than previous commitments of the Society. Consequently, if there is a latent attitude present in the formative atmosphere which would imply that the works of the apostolate, here the scientific apostolate, are bad because they draw the mind away from spiritual things and oppose the spirit of contemplation, this introduces a disturbing element into the framework of values within which the evolving Jesuit scientist develops and creates a conflict of values which tends to undermine his sense of identity. Specifically, the more probable disturbing attitude might take the form of saying that the apostolate is good when it is concerned with priestly ministries. This implies that the scientific apostolate is somehow bad or at least second best. Given the Jesuit's basically religious orientation, this attitude can have severely disturbing consequences, and it is precisely this misapprehension which the *Epitome* warns against (*Epit.* VII, 685a, 4.)

Another problem of rather large proportions is the whole question of professionalism in religious life. The religious community has been traditionally structured along more or less bureaucratic lines; that is, the structure of the Society and other religious bodies has been oriented toward efficiency in the accomplishment of large scale administrative tasks. Consequently, the organization is shaped in various ways to better achieve those ends, and it tends to emphasize certain values: centralization of power, emphasis on rules, de-emphasis on initiative, emphasis on service of the organization and adherence to prescriptions of superiors, etc. Each of these qualities and the values they represent are desirable and good. But they require certain conditions of operation, if they are to be the determining values of the work to be done. One of the major conditions is a certain lack of specificity in the jobs to be done, so that members who apply themselves to these jobs can do so indifferently with a degree of facility and some expectation of success. Obviously, this is definitely *not* the case in scientific work. The scientist is a highly skilled person possess-ing highly technical skills and knowledge. Moreover, his work demands of him a high degree of personal initiative and it requires that he function in a highly efficient manner. Consequently there is a tension in the life of the Jesuit scientist which reflects a deeper problem in the structure of religious life itself. He shares these problems with his brothers in religion but they affect him more intensely because his specialization calls for stronger commitment to the values on the professional side.

Conclusion. Let no one think, therefore, that the task is to be simple or easy. Let no one think that these problems can be worked through by the individual. They are problems which confront not merely individuals, but all of us as members of the Society. What is required, therefore, is a corporate effort in which every Jesuit has his part to play. Each of us in his own way contributes to the self-image, the sense of identity of our fellows. We can either foster that identity or we can harm it by our attitudes, responses, valuations, cooperation, encouragement, discouragement, etc. The more Jesuits there are who have the courage and abnegation to undertake and carry out the scientific apostolate, the better formed will the image of the Jesuit scientist become, the more effective will the feedback into the years of formation become, the more general will be the communication of the values we have discussed. Much of this must come about by the generation of a climate, a milieu, which is permeated by the values and objectives of the scientific vocation. We must as a group grow into the role, and as we grow into it we shall create the conditions for increasingly better fulfilment. In that sense, every Jesuit scientist has the obligation to live the values of his religious life and of his profession to his fullest capacity. If I were to put my finger on any one vital point, this would seem to be the most significant.

Growth in a sense of identity and the assimilation and internalization of the role-function proper to the Jesuit scientist is, in the final analysis, a process which requires careful consideration and intelligent planning. It is the part of the intelligent man to determine first the end, and then the means to that end. We must first decide where we are going and then set ourselves on the road to our destination. Once the image is formed, once the basic conception of the function of the Jesuit scientist is articulated in terms of the nature of the Society and its works and in terms of the particular ideals and values inherent in the Society's structure, the determination of practical means to make that image and that conception a reality are matters of administrative decision. There is no necessary obstacle to their ultimate realization.

Our Lady of Martyrs Tertianship, Auriesville, New York

THE JESUIT SEISMOLOGICAL ASSOCIATION

J. JOSEPH LYNCH, S.J.

At the request of the editor, I write this article gladly, but with some misgivings. One of the members of the Jesuit Seismological Association (JSA) with a Ph.D. in seismology, Fr. Henry Birkenhauer, S.J., lately director of the John Carroll Observatory, has just been appointed Tertian Instructor in the Detroit Province. Another member with a Ph.D. in seismology, Fr. Alexis Mei, S.J., was appointed some time ago academic vice-president of Santa Clara University. These appointments are very flattering to the JSA, but they call to mind the story of the faithful sons surrounding the deathbed of their father Jacob. While touched by the devotion of their presence, the business instinct in Jacob caused him to ask excitedly, "But if you are all here, who is minding the store?" My first misgiving then is that the focusing of attention on the JSA may cause other superiors to avail themselves of the sterling qualities of JSA members and soon we shall have no one to mind our seismic store.

The second misgiving is that it is impossible to do justice to the subject. It is impossible in a short article, to give credit to all to whom credit is due. At the outset, it must be stressed that this is by no means an account of Jesuit seismological activity but only of American Jesuit activity. The splendid work of the Canadian group in Montreal, the Australian group in Riverview, the Spanish, South American, Philippine and other groups would each call for a lengthy article. Even this account of American Jesuit activity must necessarily be sketchy.

Original stations. If one Jesuit in North America were to be singled out for the credit of having introduced Jesuit seismology, it would have to be Fr. Frederick Odenbach, S.J., at the old St. Ignatius' College in Cleveland. Fr. Odenbach had the foresight in 1909 to order from Germany sixteen of the recently developed Wiechert seismographs complete with clock and smoked paper equipment. These seismographs were then bought and set up by:

Brooklyn College, Brooklyn, N. Y.
Canisius College, Buffalo, N. Y.
Loyola University, Chicago, Ill.
St. Ignatius College (now John Carroll University), Cleveland, Ohio
Sacred Heart (now Regis) College, Denver. Colo.
Spring Hill College, Mobile, Ala.
Loyola University, New Orleans, La.
St. Louis University, St. Louis, Mo.
St. Mary's College, St. Mary's, Kan.
University of Santa Clara, Santa Clara, Calif.
Gonzaga University, Spokane, Wash.

Fordham University, New York City
Georgetown University, Washington, D. C.
Marquette University, Milwaukee, Wis.
Holy Cross College, Worcester, Mass.
St. Boniface College, St. Boniface, Manitoba, Canada.

Of these, the ones at Brooklyn and Holy Cross were very short-lived due to lack of interest. Saint Mary's, Kansas, was wiped out by flood, and in 1922 Saint Boniface, Manitoba, Canada, was destroyed by fire. The remaining twelve continued and developed, but due to differences of opinion as to the manner of cooperation, they operated as independent stations. The Gonzaga station was transferred to the philosophate at Mt. St. Michael's (eight miles away) in 1930, where it is now kept in very creditable working operation by the philosophers, currently headed by Mr. Michael Ferrigan, S.J. He acted as a very efficient host to the JSA meeting held at their delightful villa in 1962. Later stations were established at Xavier of Cincinnati in 1927, Weston in 1930, San Francisco in 1948, Montreal (affiliated with, but not a member of the JSA) in 1954, and sub-stations of St. Louis at Florissant in 1930, Little Rock in 1930, and Cape Girardeau in 1938. With the death of Fr. Joseph Carroll, S.J., the Marquette station was dismantled in 1956, but McQuaid High School in Rochester established a station in 1959 under Mr. Roy Drake, S.J.

Fr. Macelwane. Credit for coordinating and modernizing American Jesuit seismology must go to the late Father James B. Macelwane, S.J., who founded the JSA in 1925. "Father Mac," as we affectionately called him, made his early studies at St. Louis University. He took his Ph.D. in seismology—the first Jesuit to do so—at the University of California in 1923. After a year as assistant professor of seismology at Berkeley, Father Macelwane returned to St. Louis where he founded the Institute of Technology. Today this Institute, under Fathers Victor Blum, S.J., and William Stauder, S.J., flourishes as one of the best in the country and the only Catholic one. In addition to forming the JSA, Fr. Macelwane was instrumental in establishing the Eastern Section of the Seismological Society of America. Co-founders of the section with him were Captain Nicholas Heck of the U.S. Coast and Geodetic Survey, Dr. Arthur L. Day of the Carnegie Institution, and Dr. Ernest Hodgson, of the Dominion Observatory, Canada. In addition to being the first chairman of the newly-founded section, Fr. Macelwane in succeeding years became president of the Seismological Society of America, president of the American Geophysical Union, and, after election to the National Academy of Sciences, chairman of the United States Technical Panel on Seismology and Gravity for the International Geophysical Year.

These are but a few of the national offices that Fr. Macelwane held during his thirty years as president of the JSA. His textbook on seismology, co-edited with Fr. Frederick Sohon, S.J., of Georgetown University, still remains the best English textbook on seismology. A whole volume could well be devoted to what the JSA owes to "Father Mac" and the prestige that he has brought to the Society—but your editor wants an account of what the JSA is doing now, and time and space will not permit both.

Boscovich. Before leaving the early days of Jesuit seismology in America, however, credit must be given to St. Francis Xavier. In advising St. Ignatius to establish the Roman College for the training of Jesuit scientists he paved the way for our future observatories. In fact, one of the early graduates of the college, Fr. Roger Boscovich, S.J., was almost the first Jesuit geophysicist in North America. As a Fellow of the Royal Society of London, he obtained a grant to come over and lay down astronomically the disputed boundary between the colonies of Maryland and Pennsylvania. He was not interested in the dispute, but in measuring one tenth of a degree of latitude. The unusually flat terrain at the disputed boundary offered an ideal location for checking his earlier measurements made in Rome. However, the Huguenots (founded, oddly enough, by Calvin, Xavier's classmate in Paris) successfully protested to the British Government against sending a Catholic priest on such a mission, and Mason and Dixon were called in. Boscovich did however establish a chain of Jesuit observatories of which the American group later formed an important link.

Jesuit brothers. Before finally leaving the past, a word must be said of the splendid work contributed by our lay brothers to the successful results of our JSA stations. Bro. George Rueppel, S.J., was one of the early mainstays both at Cleveland and St. Louis. Bro. Nicholas Reeff, S.J. (designer of the Reeff Seismograph), is continuing the fine tradition at St. Louis. Fr. Tondorf's right-hand man at Georgetown was Bro. Charles Ramage, S.J., an excellent instrument man. Bro. William Kavanagh, S.J., filled a similar role at Fordham. These are but a few of the brothers who have done yeoman technical work on our seismographs. Would that we had more of them!

Jesuits and the IGY. The International Geophysical Year (IGY) which ran from July 1, 1957 to December 31, 1958 offered an unusual opportunity for geophysical research. Three members of JSA played a very active part in the government program at the South Pole, Fr. Daniel Linehan, S.J., Fr. Henry Birkenhauer, S.J., and Fr. Edward Bradley, S.J. Affectionately called the three "Jesuit Penguin Seismologists," they gave an excellent joint lecture with colored slides to the community and public during the JSA meeting at Fordham. All agreed that during their long winter sojourn, the droll inquisitive visits of the native penguins kept them highly amused. As Fr. Linehan remarked, he could see in some of these black-robed visitors, almost human in their mannerisms, members of a typical Jesuit community. One quite dignified, with a stately walk; another shorter and more portly, with a slouchy gait, etc.—a typical long black line!

Fr. Linehan, representing the Weston Observatory, went to the Antarctic as technical advisor to Admiral Dufek. His chief mission was to make seismic soundings and lay out the best location in the Antarctic for a landing strip for navy planes. His mission was successfully completed and the landing strip is now in constant use. Fr. Linehan had made previous trips by boat to the North Magnetic Pole in the summer of 1954 and to the Antarctic in the winter of 1954–55. In 1955–56 he returned to the Antarctic as geophysicist on the United States Naval Operation Deep Freeze. He is one of only five men who have ever completely circumnavigated the South Pole by water. This was done partly during these two visits and was completed during the third visit with Admiral Dufek. It was quite a thrill in 1958 to talk by phone from the office of the Fordham Observatory to Fr. Linehan at the South Pole by means of his amateur 40 watt transmitter. In this way, he received the New England status from us and we got news of the other two "Jesuit Penguins."

Fr. Birkenhauer from John Carroll University was in charge of the government seismological observatory at the Wilkes Antarctic Base. Here he spent a year in his igloo changing and reading the seismic records and sending regular radio reports to Washington. Little did he then think that he was being kept on ice for a future career as Tertian Instructor!

Fr. Bradley of Xavier University, Cincinnati, was in charge of the seismological observatory at the Weddell Station. This, however, was merely his home base. Most of his time was spent on weekly forays (using ice tractors) measuring ice thickness by seismic soundings in all directions from Weddell. Though he was the seismologist in charge, his duties were not confined to seismological ones. He had to help the accompanying meteorologist and biologist take their readings and keep their instruments in shape.

All three of our "penguins" said Mass daily, weather conditions permitting, and all three made many converts. Fr. Linehan has the distinction of being the first priest to say Mass on the ice at the South Pole. St. Francis Xavier must have been very proud of these Antarctic missioners. We could have used half a dozen more if we had had that number available. A fine tribute to their work is contained in a letter to the writer, from Dr. Lloyd Berkner, vice-president of the International Geophysical Year, president of the American Geophysical Union, and president of the Associated Universities (Brookhaven). Quoted in part the letter reads:

> May I take this opportunity . . . to express my very great admiration for the outstanding scientific work and scientific leadership that has been exercised by Father Linehan. I can only add that the contributions of the Jesuit Order to the whole of the IGY on a world wide basis have been most impressive. When I recall the outstanding scientific work of so many of my Jesuit friends, work of scientific quality which is so well exemplified by Father Linehan's contributions, I feel that special emphasis should be given to the vision and courage of the whole Order for their contributions to the advancement of human knowledge.

When the services of JSA were offered to the National Research Council in connection with IGY they requested six Jesuit seismologists (on a salaried basis) for polar work. The JSA is deeply grateful to the superiors who released Fr. Linehan, Fr. Birkenhauer, and Fr. Bradley for this work. Their graciousness and foresight have been rewarded with rich dividends for the Society.

International Union of Geodesy and Geophysics. Another government activity with which the JSA has cooperated is the International Union of Geodesy and Geophysics. This group meets every three years, U. S. delegates to the meeting being appointed by the National Research Council. The JSA has consistently had two delegates at the seismological sessions. I recall well the Edinburgh meeting in 1936 when Fr. Macelwane and myself were standing across the street from John Knox's church, admiring the architecture. Suddenly, the verger, in top hat and frock coat, emerged. He froze in his tracks when he saw us and then yelled, purple with rage, "No Popery!" Fr. Macelwane and I could only laugh, in those "pre-ecumenical" days.

At the 1960 meeting in Helsinki, Fr. William Stauder, S.J. of St. Louis gave an excellent paper on fault plane work (determination of the faulting mechanism of an earthquake from distant seismic records). Another excellent paper on vibration analysis by Fr. Henry Birkenhauer, S.J., of Cleveland, was read by the writer. A cocktail party was arranged for the Russian seismologists by the American group and we were able to meet all of the Russian seismologists on a very friendly basis. They double-crossed us on one score, however: they all drank Scotch and left us with the vodka. Their chief seismologist was Dr. Beloussov, who speaks perfect English. He was elected president of the Union and will preside over the 1963 meeting in California. Following the 1960 meeting, Dr. Beloussov was appointed by UNESCO to head a committee which visited South America, the Middle East and the Far East. Their purpose was to investigate seismic conditions in these countries and to report on how building codes and instrumentation could be improved. Fr. Linehan was one of the committee of five who visited all these countries and co-edited the report.

St. Peter's tomb. One of the most interesting activities of JSA in recent years was its minor participation in the excavations at the Vatican locating St. Peter's tomb. It was quite a thrill for Fr. Linehan and the writer to gaze down on the actual earth in which the headless bones of St. Peter had been discovered. The bones themselves had been taken to the Papal quarters for analysis. Our main objective had been to locate Nero's circus, in the center of which St. Peter was known to have been crucified. No trace of the circus was found, partly because it was impossible to use dynamite in the suspected area because of the honeycomb of gas mains, partly because most of the stone work of the then unused circus was undoubtedly used by Constantine in the building of his Basilica. We used an electromagnetic hammer which was a poor substitute for dynamite on the outside. Inside, it was excellent, and we ran profiles in the excavations and verified that the cemetery which had been discovered had no under-layer.

Detection of nuclear explosions. The need for more effective detection of nuclear blasts has led to heavy support by the United States government for seismological research. This is handled by the Air Force Office of Scientific Research (AFOSR). One phase of the project has been to equip one hundred and twenty-five seismological stations with identical equipment of the highest calibre. All records of the stations are sent to Washington where they are microfilmed and made available to any research workers. Ten percent of the stations so far set up are Jesuit stations. Four are members of JSA: Weston, Georgetown, Mobile and Florissant. The committee was faced with a problem in making the allotment—only one set could be assigned to a given area. Harvard was bypassed in favor of Weston. Fordham was bypassed in favor of Palisades, and one of our best stations, Cleveland, was bypassed in favor of her sister station at Florissant.

Another phase of the project is the awarding of contracts to universities for basic seismological research. Most JSA stations are, or have been, engaged in some part of this phase. In the interest of space an account of such work must be deferred for some future article.

To end where we began, this is only a sketchy account of some of the activities of the Jesuit Seismological Association. A parting tribute should be paid to Fr. William Repetti, S.J., the oldest living member of the Eastern section of the JSA. Currently the archivist at Georgetown University, he attended the last Washington meeting of the Association. His seismological work, mostly carried out in the Philippine Islands, would call for an article in itself.

In closing, it can be seen that the most urgent need of the JSA is more personnel!

FORDHAM UNIVERSITY

REPORTS OF SCIENTIFIC ACTIVITY

High Schools

Boston College High School. An enthusiastic student response to the new CHEM Study program has given the chemistry department grounds for optimism concerning its future success.

Mr. John A. Hanrahan, S.J.

Fairfield Prep. Fr. Eugene C. Brissette, S.J. continues to use the CBA in the junior chemistry course. Fr. Brissette and Mr. William Aylward, S.J. are both attending an in-service institute for secondary school teachers of science and mathematics.

Fr. John McGrath, S.J., of the physics department, spent the past summer at the Lawrence Radiation Laboratory, Berkeley, California, doing research under an NSF grant.

With the assistance of Mr. Vincent Martin, the physics department is organizing an amateur radio club. At present there are thirty-five members interested in establishing a radio station at the school.

Fr. John Greene, S.J., of the mathematics faculty, is taking a Saturday course in linear algebra at Fordham University. This year his Math Club is studying number theory.

Thirty members attended the first meeting of the Angelo Secchi Science Academy this year. The academy is a member of the Future Scientists of America Club and aims to increase knowledge of and interest in science.

Fr. Eugene C. Brissette, S.J.

Colleges and Universities

Boston College. As an aid to the new arrivals at Boston College, this year's Freshman orientation program included a panel discussion of ideas of modern science. The panel consisted of Professor Frederick White, of the physics department, Fr. James W. Skehan, S.J., of the geology department, and students Philip Leonard, class of '64, and Thomas Brady, class of '63, majors in mathematics and chemistry, respectively.

Geology. Fr. Skehan's speaking engagements over the past few months included the presentation of a paper entitled "Geological section in Central Massachusetts" to the Geologists of Southern New England, a lecture and discussion on the "Geology of New England" to the combined Kansas Geological Survey and University of Kansas staff, a lecture on the "Geology of Vermont" to the geology department faculty and student body at Brown University. His other activities included studies of the deep anthracite coal mines of the Wyoming-Lackawanna basins of northeastern Pennsylvania, and of the deep salt mines in the Finger Lakes region of New York, as part of his investigations of the regional geology of the Appalachian Mountain system.

Fr. Skehan has signed a contract with Rand McNally and Company for a book entitled *Regional Tectonics of Selected Portions of the World* with projected publication date being 1965. This is the first of a series of projected books in the Earth Sciences under the editorship of Lawrence Sloss of Northwestern University.

Fr. Skehan, Mr. George D. Brown, Jr., and three graduate students attended the annual meeting of the New England Inter-Collegiate Geology Conference hosted by McGill University, Montreal.

As part of an NSF-sponsored undergraduate research participation program, five undergraduate geology majors are participating in research on continuing projects in the department relating to stratigraphy, structure, and microscopic petrology of East-Central Massachusetts, regional geology studies of selected parts of Continental United States, and geohydrology studies in New England.

Mr. George D. Brown, Jr., has joined the geology department as the second full-time faculty member. He has had previous teaching experience at Colgate and Indiana Universities, and at the Indiana University summer field station in the Rocky Mountains of Montana. Mr. Brown's Ph.D. thesis research was on the paleontology of a part of the Bluegrass region of Kentucky. His future research will include a study of the bryozoa of Vermont and New York.

Peter J. Solomon, a graduate of the University of Queensland, Australia, and Ph.D. candidate at Harvard University, is a lecturer in the department of geology. Mr. Solomon has served as consultant to the Mount Isa silver, lead, zinc, and copper mine, the largest mine in the world.

Fr. James W. Skehan, S.J.

Physics. Boston College has received a $95,000 grant from the AEC to continue a nuclear studies program which began two years ago under an initial $80,000 AEC grant. The program consists in charting the characteristics of some twenty-four elements under neutron bombardment from the 400,000 volt Van de Graaff accelerator. The work is under the direction of Dr. Robert L. Becker, of the physics department, who describes the work as "measuring the angular distribution of the elastic scattering of neutrons as a feature of atomic weight." Assisting Dr. Becker this past summer under the undergraduate research participation program, were two Boston College senior physics majors.

Projects for the future include plans for studying inelastic neutron scattering and the subsequent gamma ray emission. Additional equipment and a larger accelerator will be needed for such work.

Fr. William G. Guindon, S.J.

Canisius College. Senior projects have been of long standing in the chemistry and physics departments. This year physics majors were given the first semester of senior year for a project which they chose themselves with the approval of the staff. One senior has finished building a preamplifier for use with semiconductor alpha detectors. The circuit was provided by the courtesy of Dr. G. L. Miller of the Brookhaven National Laboratories. It is planned to use this unit in the second semester laboratory program.

Physics. Dr. Daniel F. Dempsey has worked out a new idea for an old experiment that may be of interest for elementary laboratories. A PSSC momentum cart is attached to a variable angle coefficient-of-friction apparatus and used as a launcher for small steel spheres. A 3×3 foot piece of cardboard, which has a 6 inch diameter hole cut in it at the appropriate place, is hung from the ceiling. A container is placed at the right distance for catching the ball. The instructor fires the ball several times and permits the students to measure all of the relevant distances, but not the angle of the launcher. The students must calculate the angle and then are individually allowed to try the instrument. The apparatus allowed about a 0.5 degree variation from the original angle.

A typical problem for introductory quantum mechanics is a numerical integration of the potential well. After the class had been introduced to the tediousness of this problem, Fr. J. J. Ruddick, S.J. and an IBM engineer worked out a 1620 computer program for the problem and explained it to the class. Later the class ran the program on a 1620 computer at a local technical high school.

Fr. James J. Ruddick, S.J.

Fordham University. Fr. J. Joseph Lynch, S.J., director of the Fordham University Seismological Observatory, is the new president-elect of the New York Academy of Sciences, one of the largest scientific societies in the world. Fr. Lynch was also re-elected president of the Jesuit Seismological Association at the annual meeting in Spokane.

Astronomy. Recent publications by Fr. Walter J. Miller, S.J., in collaboration with Dr. Arthur A. Wachman of the Hamburg Observatory, Hamburg-Bergedorf, Germany, include: "Ten Eclipsing Variables in the Cygnus Cloud, VV 92–101" and "Six RR Lyrae Variables in the Cygnus Cloud, VV 102–107" in the Vatican Observatory's astronomical periodical, *Ricerche Astronomiche.* The articles appeared in the May and June, 1962 issues and are the eleventh and the twelfth to be issued by Fr. Miller since he founded the Fordham University Astronomical Laboratory in 1955.

Fr. Walter J. Miller, S.J.

Chemistry. Drs. Bartholomew Nagy and Michael Cefola, both associate professors in chemistry, presented papers at the International Meeting of Organic Processes in Geochemistry held in Milan, Italy, on September 10–12. The conference was organized by the European branch of the Organic Geochemistry Group under the co-sponsorship of the Societa Chimica Italiana, Sezione Lombardia. The presentation of the papers was by invitation only. Dr. Nagy discussed the "Fossilized organic micro-structures in carbonaceous meteorites" and Dr. Cefola "The use of C-14 labeled compounds in chromatographic studies of asphaltic matter." Several hundred geochemists from all parts of the world, were present at the meeting. Dr. Nagy's trip was sponsored by the NSF and Dr. Cefola's by the AEC.

The following papers were presented by members of the chemistry department at the 142nd national meeting of the American Chemical Society held in Atlantic City, September 9–14:

Dr. Emil J. Moriconi, Mr. Francis A. Spano, and Dr. William F. O'Connor, "Ozone as an electrophile and nucleophile in the ozonization of acridine and phenanthridine, their N-oxides and quinoline-1-oxide."

Dr. Douglas J. Hennessy and Mr. Ramon A. Salomone, S.J., "Synthesis and toxicity of some prolan analogs."

Dr. Douglas J. Hennessy and Mother Daniel O'Brien, R.S.H.M., "A model free radical system for inactivation and detoxication of and intoxication by DDT."

Dr. Norman O. Smith and Sister Xavier Brady, O.P., "Phase relation in the system anthracene-phenanthrene."

Dr. Douglas J. Hennessy and Mother Daniel O'Brien, R.S.H.M., "Bromine atom-initiated autoxidation of 1,1,1-trichloro-2,2-bis(p-chlorophenyl)ethane (DDT)."

The University has received a two-year grant from the NSF for the support of research entitled, "Structural, biochemical and physico-chemical studies of lignins". The research is to be conducted under the direction of Dr. Friedrich F. Nord, professor emeritus of organic chemistry and enzymology and a recognized authority on lignin. This waste wood product is potentially the source of chemical products such as vanillin and aspirin now obtained from coal tar. In a January, 1960 issue of the *Journal of the American Chemical Society*, Dr. Nord and two Fordham associates stated that research work they had done led to the belief that the source of lignin had been discovered. The waste product belongs to the family of aromatic compounds on which the dyestuff and pharmaceutical industries are largely built, and from which come some of the most useful plastics. Dr. Nord retired from active teaching at the end of the 1960 academic year. He has continued to do research work, and has been associated with the university since 1938.

Dr. Walter J. Shubert, professor of chemistry, is co-author of a chapter entitled, "The biochemistry of lignin formation," appearing in *Comparative Biochemistry*, Volume IV, 1962, published by Academic Press, New York.

Dr. Bartholomew Nagy and Dr. Norman O. Smith have received a renewal grant of $19,000 from the NSF for another two years of research into the "Solubility of gases in connate water." This is part of an overall program concerning the occurrence of petroleum and natural gases in sedimentary rocks. Studies of the solubility of gases will be made at pressures up to 10,000 pounds per square inch, simulating pressures to be found at considerable depths below the earth's surface. Dr. Smith was also awarded a grant of $15,640 by the Petroleum Research Fund of the American Chemical Society. The purpose of the grant is to enable Dr. Smith to conduct a two year study of "Clathrates of Werner complexes."

The chemistry department has eleven grants totaling $140,200 for the year 1962–1963. Besides those mentioned, grants have been received by Dr. Cefola, Dr. Gentile, Dr. Moriconi and Fr. Dillemuth, S.J. Grants totaling $500,000 have already been applied for the next year.

Dr. Leo K. Yanowski was given the *Encaenia* award for his (College) class of 1927 by the graduates of the class of 1962.

Fr. Robert D. Cloney, S.J.

Physics. Two new additions to the physics department staff are associate professor Joseph Budnick and associate professor Irving Zinnes. Dr. Budnick is a graduate of St. Peter's College, and received his Ph.D. at Rutgers University. He has been working for the past five years for the IBM Corporation in solid state physics and is starting a program in nuclear magnetic resonance at Fordham. Dr. Zinnes has been on the faculty of the University of Oklahoma for a number of years, and spent the last two years at Princeton University as a research associate in theoretical physics.

Fordham has received another grant from the NSF to conduct an institute for high school physics teachers next summer. The institute will again be devoted to the PSSC new high school course, and Fr. Fred Canavan will be the director.

The Department of Health, Education and Welfare has awarded two additional fellowships in theoretical physics to the Fordham physics department under Title Four of the National Defense Education Act. This brings to eight the number of NDEA fellowships in the physics department.

Fr. Mulligan served on the selection committee for the NSF science faculty fellowships in Washington at the end of November.

The new curriculum for physics and mathematics majors has caused considerable comment throughout the country. This program does away with the standard introductory physics course. The students take a double mathematics course in freshman year, and intermediate courses in mechanics and electricity and magnetism during sophomore year. The program, under the direction of Fr. Charles Lewis, S.J., chairman of the mathematics department, is being supported for two years by the NSF. Professor Joseph Shapiro of the physics department discussed the new program at the recent Ann Arbor meeting of the committee on curricula for physics majors of the American Association of Physics Teachers.

Fr. Joseph F. Mulligan, S.J.

Georgetown University. Twenty top science students from three high schools in the District of Columbia participated in an eight-week seminar in technical writing conducted during the past summer at Georgetown University by Mr. John V. Clark, White Oak Naval Ordnance Laboratory technical writer. The idea for the seminar was conceived last spring following a biology honors seminar conducted at Gonzaga High School by Fr. Robert F. Mullan, S.J. The twenty students from Gonzaga, Georgetown Visitation, and Sidwell Friends High Schools were selected on the basis of proven scholastic ability. The subject matter of the course began with fundamental writing techniques and progressed through several basic technical writing forms. The opening sessions were devoted to the application of readibility indices, basic literary structures and devices fundamental to technical writing and the discipline of outlining. These were followed by an analysis of various audiences encountered. The remaining sessions were devoted to specific technical writing forms, such as procedural and descriptive exposition. A second seminar has been planned for the spring of 1963.

Astronomy. Fr. Francis J. Heyden, S.J. has been appointed as consultant to the NASA headquarters and during the spring semester of 1963 he will give a series of lectures on the fundamental principles of celestial mechanics and orbit theory to the NASA headquarters' personnel.

Fr. Martin F. McCarthy, S.J. and Dr. Vera C. Rubin have begun densitometric measurements on objective prism plates which were taken with the new Vatican Observatory Schmidt telescope and loaned to Georgetown. They are especially interested in measurements in the ultraviolet, in order to determine luminosity and metal-abundance criteria. These same plates are being used by Fr. McCarthy for classroom instruction in the identification of stellar spectral types.

An eight-degree objective prism has been mounted in the 5 inch refractor at Georgetown and a program of photography with this instrument has been initiated.

Dr. Rubin's paper on "Kinematic studies of early type stars. I. Photometric survey, space motions and comparisons with radio observations" was published in the November issue of the *Astronomical Journal.* Last year's graduate class in statistical astronomy collaborated with Dr. Rubin in this work. This study is being continued.

Mr. Benny L. Klock is using the 12 inch equatorial for photoelectric observations in three colors with three narrow-band interference filters. His plans are to determine the strength of the CH and CN bands and the break at the K line of CaII for F, G and K supergiants and selected Cepheids. This information will yield indices for two-dimensional spectral classification.

Mr. Robert Cameron spent two weeks during the month of October, 1962 at the Kitt Peak National Observatory, using the 16 inch reflector which was installed in the summer of 1962. Magnetic and probably-magnetic stars were observed in order to develop criteria by which stars, which are likely to exhibit a measureable Zeeman pattern, may be isolated.

Mr. Whiting R. Willauer spent several days at the McDonald Observatory which is conducted jointly by the University of Chicago and the University of Texas. His observations with the 36 inch reflector are part of a long-term program of Dr. G. de Vaucouleurs, of the McDonald Observatory staff, on the photometry of extra-galactic nebulae. Dr. Rubin has collaborated with Dr. de Vaucouleurs in this work and Mr. Willauer plans to continue work in this area under Dr. Rubin's direction.

Under the direction of Fr. Heyden, members of the observatory staff collaborated with NASA in making photometric and micrometric measurements of films of several Echo Balloon-Satellite flights.

At the December Astronomical Colloquium, sponsored by Georgetown Observatory for the professional astronomers of the Washington area, Dr. K. L. Hallam of NASA spoke on "A photometric study of interstellar absorption."

At the December Students' Astronomical Colloquium, Mr. Erich Rutscheidt spoke on "M, C, S stars and the H-R Diagram" and Mr. Clayton Smith spoke on "Recent determinations of the galactic center."

Fr. Francis J. Heyden, S.J.

Holy Cross College. The awards for NSF summer institutes for high school teachers have been renewed. One institute will include the fields of biology, chemistry and physics; another will be conducted in mathematics.

Chemistry. Curriculum changes: Most of the curriculum changes that have been made or will be made in the near future are those recommended recently by the American Chemical Society. Organic chemistry is now being taught in sophomore year. The mechanistic approach to organic chemistry, used last year by Dr. McMaster with the chemistry majors, is being used this year for all organic chemistry students. Analytical chemistry will be taught from both the organic and inorganic points of view and will begin in junior year. Physical chemistry will also begin in junior year. The textbooks being used in organic and physical chemistry are:

Organic Chemistry, Morrison and Boyd.

Laboratory Manual of Organic Chemistry, Coleman, Wawzonek and Buckles.

Physical Chemistry, Daniels, Alberty et al.

Experimental Physical Chemistry, Daniels et al.

It is expected that the full transition to the new curriculum will take three years. It is hoped that in the future advanced physics and mathematics courses will be part of the elective program in senior year. Graduate courses are now being made available to advanced placement and honors students.

Dr. Robert W. Ricci of the chemistry staff worked this past summer with the United States Army Quartermaster Corps on photoisomerization.

Dr. Andrew Van Hook conducted a one day seminar on crystal growth for the chemical engineering graduate group at the University of Utah.

Fr. Bernard A. Fiekers, S.J. represented the ACS at the inauguration of Dr. H. P. Storke as president of the Worcester Polytechnic Institute.

Physics. The Holy Cross physics department was host to the Worcester Physics Colloquia in Haberlin auditorium where Dr. Rustgi of the Smithsonian Astrophysical Observatory discussed the properties of thin films.

Dr. Roy C. Gunther, who was at one time on the physics staff of Clark University, has joined the staff of the Holy Cross physics department.

Fr. Bernard A. Fiekers, S.J.

St. Peter's College. Fr. Joseph Schuh, S.J., former chairman of the biology department, left last August for Lagos, Nigeria where he will assume the position of senior research fellow at the newly established Federal University of Lagos. Fr. Schuh's new address is: Semisola Road, Suru Lare, P.M.B. 1043 Yaba, Nigeria.

Biology. Fr. Rocco Belmonte, S.J. recently joined the staff and will teach genetics and histology.

The establishment of a tissue culture laboratory has been initiated under the direction of Fr. Jerome Gruszczyk, S.J. A sum of $600.00 has been alloted to the department from an NSF grant and will be used for the purchase of laboratory equipment.

Three small rooms have recently been converted into student research laboratories where twenty students are presently engaged in research projects. Two of these students are studying the inhibitory effect of a reserpine derivative on the neuro-secretory action of the pituitary in the goldfish (*Carrasius auratus*) under heat stress.

Fr. Jerome H. Gruszczyk, S.J.

Wheeling College. The fall Chemistry for Industry program consisted of four lectures on corrosion. The speakers and their topics were: Professor Norbert D. Greene, "The theory of corrosion"; J. B. Bialosky of Koppers Co., Inc., "Corrosion in liquid streams"; Robert P. Buhrow of the Standard Oil Company, "Erosion in solid streams"; and F. L. Whitney, Jr., of the Monsanto Chemical Company, "New materials."

Chemistry. The NSF has awarded a matching-funds grant of $12,000 to the chemistry department to be used for the purchase of equipment to improve the undergraduate program.

Hubert McDonald, a junior chemistry major, was one of the twenty chemistry majors who attended the summer program in inorganic chemistry at Reed College under an NSF grant.

Fr. Joseph A. Duke, S.J. was engaged during the summer as a research participant at Oak Ridge National Laboratories. (See the June, 1962 issue of this BULLETIN, page 52.)

The NSF has awarded a student participation grant of $4200 to the chemistry department. Under this program two undergraduates are working with each of the three chemistry professors on their present research projects. This program will challenge those students whose past training and present capabilities give promise of an outstanding future in the field of science.

The Science Workshop program for science teachers of the area consists of a series of lectures followed by laboratory sessions designated to introduce the dimension of experiment into the workshop topic. Nationally-known science educators present the lectures and the department faculty conduct the lab sessions. Guest speakers include the following: Professor Henry S. Frank, University of Pittsburgh; Dr. David Doherty, Oak Ridge National Laboratory; Professor Alfred B. Garret, Ohio State University; Professor E. H. Sorum, University of Wisconsin; and Professor Warren Brandt, Kansas State University. The topics to be discussed include the following: equilibrium, biochemistry, oxidation-reduction, mathematics for scientists, and acid, bases and salts.

Dr. Robert Grob of the chemistry department is participating in the West Virginia Visiting Scientist Program. Fr. Duke is participating in both the West Virginia and Ohio State Visiting Scientist Programs.

Fr. Joseph A. Duke, S.J.

Scholasticates

Shrub Oak. During the fall semester the Loyola Science Academy conducted a program of guest and student lectures. The guest lecturers included: Fr. Timothy P. Reardon, S.J., of Regis High School, who spoke on the new SMSG approach to logarithmic and exponential functions; Fr. Joseph F. Mulligan, S.J., chairman of the physics department of Fordham University, who gave a slide lecture on the fundamentals involved in the development of masers and lasers; Mr. Felix Germino, of the American Machine and Foundry Company, who spoke about his own research into Amylose-V complexes. Student papers included "Molecular configurations of organic chemistry" by Mr. Michael A. Fitzgerald, S.J. (*N.Y.*) and "Some aspects in the progress of genetics" by Mr. William J. R. Rogan, S.J. (*Md.*). A series of scientific films have been shown by the academy and the members of the academy attended a movie and lecture at the Con-Edison Nuclear Power Plant at Indian Point, N.Y.

Physics. Fr. Thomas Cullen, S.J. (*N.Y.*) reports that the Institute of Physics of the Catholic University of Brazil has been awarded a $23,000 contract by AEC which will enable himself and Fr. Francisco Roser, S.J. to continue their investigation of natural radioactivity and contamination. Recently a supplementary request for $24,000 was submitted to finance a cooperative investigation with Dr. Merril Eisenbud's group at New York University. This phase of the investigation will center upon Ra 228 counts in the radioactive regions of Brazil. Measurements have already been made on water, fruits and human teeth with positive results.

Mr. Bernard R. Malara, S.J. (*N.Y.*) has completed his work at Fordham University for a master's degree in physics.

Fr. James Fischer, S.J.

Spring Hill. The Assumption Hall Observatory which is now under the direction of Mr. Donald Ziemba, S.J. (*Pol. Min.*) and Mr. Martin Gallagher, S.J. (*Md.*), was dedicated on September 15. The observatory consists of a circular block building topped by an 8-foot-high aluminum dome. It houses a 12½ inch Newtonian reflector which has an electric motor drive. Mr. A. Ransom Marlow, S.J. (*N.O.*), who is presently studying physics at Georgetown University, began grinding the 12½ inch parabolic mirror in 1956. In 1959 Mr. Don Cordero, S.J. (*Calif.*) and Mr. John Thompson, S.J. (*Calif.*) built the present telescope, using parts of an old printing press for a fork-type mounting. The building itself was completed during the past year under the supervision of the present directors. At present a motor is being installed to rotate the dome and plans are under way to install setting circles and a camera mounting for the telescope.

Physics. The Nobel Prize winner in physics for 1961, Dr. Robert Hofstadter of Stanford University, spoke to the community on October 18 about his pioneering studies in electron scattering. Dr. Hofstadter came to the house of studies as part of a two-day visit to the Spring Hill Campus arranged through the American Institute of Physics and the NSF.

Mr. Robert J. Paradowski, S.J.

Weston. Fr. Joseph Casey, S.J., of the philosophy faculty, is now moderator of the Weston Science Colloquium, replacing Fr. Walter Feeney, S.J. who is presently working at Berkeley. Mr. Donald Plocke, S.J. (*N.E.*) is chairman for the current year and Mr. Maurice LeBel, S.J. (*N.E.*) is secretary. The colloquium began its eleventh year on September 30 with a talk on particle accelerators by Mr. E. Alfred Burrill, vice president and director of marketing for the High Voltage Engineering Corporation. Mr. Burrill reviewed the various types of particle accelerators currently being used for fundamental research and industrial applications, and described the basic characteristics of the nuclear particles and radiations produced by these accelerators. "DNA and the genetic code" was the subject of the November Colloquium, presented by Fr. William D. Sullivan, S.J., chairman of the Boston College biology department. Fr. Sullivan reviewed the experimental evidence for DNA as the substance involved in the transmission of hereditary characteristics, and discussed the structure of DNA in relation to the currently proposed mechanism for its duplication and transmission to daughter cells. This led to a discussion of the mechanism by which genetic information is thought to be coded by the DNA molecule. Dr. George W. Pratt of the department of electrical engineering at MIT discussed the magneto-electric effect at the December colloquium. This effect, proposed theoretically by Landau in 1960, was verified experimentally in chromic oxide in 1961. Dr. Pratt described his own work, a theoretical explanation for the basic mechanism underlying the effect.

Biochemistry. Mr. Donald J. Plocke, S.J. (*N.E.*) published an article entitled, "Interaction of alkaline phosphatase of *E. coli* with metal ions and chelating agents," in *Biochemistry*, 1 (1962), 1039–43.

Physics. A project has been initiated at Weston to explore the use of the pulsed laser as a light source for Raman spectroscopy. In Raman spectroscopy the physical constants of molecular configurations are obtained by studying the spectrum of the scattered radiation emitted when transparent crystals or liquids are illuminated by monochromatic radiation. Since the scattered light is extremely weak, past work has required very powerful light sources and lengthy photographic exposures. Recent developments in laser optics, however, have enabled the experimenter to produce extremely powerful pulses of monochromatic radiation. Early work by Porto and Wood (*Journal of the Optical Society of America*, 52 (1962), 251) has proved the feasibility of using the laser for Raman work.

The goal of the present project is to achieve an efficient system which will permit photography of Raman spectra with five to ten pulses from the laser in a duration of from two to five minutes. The laser to be used is a ruby rod 2 by ¼ inches, housed in an elliptical cavity and triggered with a linear xenon-filled flash tube. The experimental group includes the following: Mr. William J. Burke, S.J. (*N.E.*), Mr. William R. Callahan, S.J. (*N.E.*), Mr. Hernando Correa, S.J. (*Colomb. Orient.*), Mr. James M. Schecher, S.J. (*N.E.*) and Mr. Alfred O. Winshman, S.J. (*N.E.*).

Mr. Donald J. Plocke, S.J.

Woodstock. A paper on "Comparative spectrophotometry of selected areas on the lunar surface" by Mr. George V. Coyne, S.J. (*Md.*) was published in the February issue of the *Astronomical Journal.* (See the December, 1962, issue of this BULLETIN, page 86.)

Mr. Agerico L. Esquivel, S.J. (*Phil.*) recently completed his doctoral studies in physics at St. Louis University. A paper based on a portion of his dissertation and written jointly with Mr. Victor L. Badillo, S.J. (*Phil.*) was delivered at the computer session of the physics-chemistry meeting of the American Crystallographic Association at Villanova University. The paper was entitled "Application of the IBM 1620 FORTRAN to electron diffraction formulae." Mr. Esquivel's article on "Electron optical investigation of thin films of lithium on tantalum, platinum, and carbon substrates" was published in the *Journal of Applied Physics,* 33 (1962), 2613–2618. Supported by the Argonne National Laboratories, the investigation was carried out under the direction of Dr. Alfred H. Weber of the St. Louis University physics department. An abstract of the research on the lithium films follows:

Thin films of lithium, when evaporated onto well polished, chemically cleaned and outgassed Ta and Pt substrates, formed uniformly thick layers (in the range 240 to 1600 A) suitable for the proton-neutron reaction in the Van de Graaff generator. A thin carbon coating (about 300 A thick), evaporated upon the Li film from a heated carbon filament immediately following the deposition of lithium on Pt and Ta substrates, insulated chemically the lithium from the air with its water vapor content and also provided carbon replicas of the Li film surface for electron microscopy. Proton bombardment of the carbon coated lithium films had no visible effects on the carbon coating nor on the Ta and Pt substrate. However, after a proton beam bombardment of 10 microamp-min at 1.88 Mev, the Li films gave evidence of some initial damage (growth of grain size plus surface unevenness) which appeared to anneal away with subsequent bombardment. Orientation effects were observed in the Li films deposited upon carbon substrates (in turn deposited on nickel lectromesh grids) in a special evaporator, attached to and forming a part of the vacuum system of the electron microscope (RCA Type EMU-2B), in order to avoid contamination of the Li with the laboratory atmosphere. Electron diffraction patterns revealed the following: (1) random orientation for the thinner (240 A) Li films; (2) preferred orientation of the (110) and (200) planes, nearly perpendicular to the surface for the thicker (1600 A) films.

From September, 1961 to September, 1962, Mr. Robert C. Baumiller, S.J. (*Md.*) was an NSF postdoctoral fellow and worked with Dr. James F. Crow in the department of medical genetics at the University of Wisconsin. An abstract of the research in the area of radiation genetics, using the *Drosophila melanogaster*, is as follows:

Flies containing a virus which causes CO_2 sensitivity were shown to be more gravely affected by radiation-induced mutants in heterozygous condition, than sibling strains free of the virus. Different strains of virus-containing flies were also shown to vary in the degree of deleterious effect, depending on the stability of the viral presence. These findings open up an area of investigation which may lead to insights into the relationship of the virus to its host and the degree of genetic adaptation the host has undergone on the way to changing a parasitic relationship into a commensal one.

Other studies included an investigation of the lethality caused by accumulated point mutations. It was shown that in the egg stage, at least, such mutants do not cause an increase in the expected lethality. Several chemicals proposed as sterilizing agents for the control of destructive insects by the Department of Agriculture were shown to have a mutagenic effect and, therefore, to be of doubtful use in protecting food crops.

An article on "Varying orbital exponents in molecular orbital theory," by Mr. James T. Dehn, S.J. (*N.Y.-Phil.*) was published in the December issue of the *Journal of Chemical Physics.* This article is part of a thesis written while Mr. Dehn was an NSF cooperative graduate fellow at Georgetown University. An abstract of the article follows:

By means of the variational principle a set of conditions is derived for the orbital exponents which minimize the energy in the LCAO form of molecular orbital theory, using Slater atomic orbitals. These equations are to be solved simultaneously with Roothan's conditions for the best LCAO coefficients. The method is illustrated for the molecular ion H_2^+ and the molecule He_2.

Mr. James F. Salmon, S.J.

Graduate Studies and Research

Catholic University. During the current year Mr. Louis Savary, S.J. (*Md.*) and Mr. Edward Sommerfeldt, S.J. (*N.O.*) are on NSF cooperative fellowships in mathematics and physics respectively; and Mr. Florian Muckenthaler, S.J. (*Mo.*) and Mr. Patrick MacNamara, S.J. (*Wisc.*) have NSF graduate fellowships in biology.

Father Paul R. Beining, S.J. (*Md.*) has recently completed the requirements for the doctorate in biology. An abstract of his doctoral dissertation on "Biochemical and cultural studies on *Staphylococcus aureus* grown *in vitro* and in an animal environment" follows:

A survey of several biochemical, serological and animal virulence tests was conducted on a strain of *Staphylococcus aureus* grown on an artificial medium (strain VSB). A comparison, using the same tests, was made with the same strain after it had passed through the peritoneal fluids of an infected animal (strain GSB).

The two strains were found to be similar in bacteriophage-typing sensitivity, antibiotic and sulfa sensitivity, DNA-base composition, several tube fermentation tests and qualitative production hemolysins, and known staphylococcal-soluble products. By quantitative procedures, however, strain GSB produced significantly more alpha and beta hemolysins, hyaluronidase, and DNase than did the VSB strain. Colonial variation on plate fermentation tests showed both strains to be a mixture of variant populations.

The GSB strain showed less ability than the VSB strain to grow on potassium tellurite-glycine agar, staphylococcal minimal agar, polymyxin B agar, phenylethyl alcohol agar and on nutrient agar containing human gamma globulin. The exogenous respiratory rate of the GSB was higher but the endogenous respiratory rate was lower than that of the VSB strain.

The GSB supernatant fluids gave a minimum of 3–4 precipitation bands in the Oudin and Ouchterlony agar-gel precipitation procedures; VSB supernatant fluids were incapable of producing any such bands with these same procedures. Tube agglutination tests with antiserum prepared against zephiran-killed cells indicated dominant antigens which differed in the GSB and VSB strains. The GSB strain showed greater virulence with less cells or less supernatant fluid by the intraperitoneal route in mice, and by the intradermal and intravenous routes in rabbits.

Mr. Louis Savary, S.J. (*Md.*) was awarded the master's degree in October, 1962. A summary of his thesis completed under the direction of Dr. Tetsuo Kawata, visiting professor from the Tokyo Institute of Technology, follows:

In analytical probability theory, particularly in limit theorems of the theory of probability, the Fourier-Stieltjes transform of a distribution function (the characteristic function)

$$f(t) = \int_{-\infty}^{\infty} {}^{itx}\, dF(x)$$

may be effectively used. Nevertheless, it seems that there are some cases where certain integral transforms of the characteristic function would be more conveniently and profitably employed in Fourier analytical treatment of the characteristic function itself. Three such integral transforms were studied in this thesis: the Dirichlet integral of the characteristic function, the Fejér integral of a characteristic function and the Poisson integral of the characteristic function. In a fourth section the mean concentration function is discussed.

In each section unpublished theorems of Dr. Kawata have been proven. The applications of these integral transforms as presented in this study are not of a concrete nature but form rather a discussion of the basic properties of the transforms. In some cases minor original results were found; in other cases simpler and more elegant derivations of some major theorems in the theory of characteristic functions were given. Also extensions of Lévy continuity theorems resulted from the study.

Mr. Florian Muckenthaler, S.J.

Fordham University. Fr. Joseph Squadroni, S.J. (*Uruguay*) has been awarded a Guggenheim Fellowship to study the marine invertebrates of estuaries. He will work at Woods Hole, Massachusetts, and at the Chesapeake Biological Station, Maryland.

Fr. Richard Cronin, S.J. (*Upper Can.*), Ph.D. candidate, was awarded a Sigma Xi Fellowship and a predoctoral fellowship from the Province of Quebec Ministry of Youth to aid his graduate research program.

Mr. James F. O'Brien, S.J.

St. Louis Unversity. Fr. James W. Felt, S.J. (*Calif.*) is currently working towards his Ph.D. in philosophy. His doctoral dissertation will concern Whitehead's philosophy of time.

Mr. Stephen F. Dubas, S.J. (*Upper Can.*) will conduct research for his Ph.D. in physics on the Schottky deviation in thermionic and photoelectric emission from single crystals grown in fine tantalum wires.

Fr. Gabriel LeBlanc, S.J. (*Lower Can.*), with a master's degree in geophysics from Boston College, is continuing his studies in seismology.

Mr. Thomas Dundon, S.J. (*Wisc.*) expects to receive his Ph.D. in biology in June, 1963. His special area of interest includes plant physiology, cyto- and histo-chemistry, and the role of phytophagous insects in production of abnormal plant growth. An abstract of the research for his dissertation follows:

A comparative study of three specifically different *Pachypsylla* insect galls on the leaves of *Celtis* (Hackberry) is being made. A cytological, cyto- and histochemical, as well as an insect behavioral study was made of these three insect galls. Particular attention was directed to the cytological antecedents and the nature of a multinucleate giant cell that occurs in only two of the galls. In these two galls, it was noted that the behavior of the inducing insects was static during the formative stages of the multinucleate giant cell. In the other gall the insect was actively feeding from the earliest stages of gall growth and showed no comparable static behavior.

A biochemical analysis of gall and normal leaf was made to determine any obvious nutritive advantage the gall provides the indwelling insect. The gall tissue contains nearly three times the protoplasmic carbohydrate of the normal leaf. Gall homogenate gives a positive Hopkins-Cole test, which is suggestive of the presence of an unknown indole compound. Total nitrogen in leaf tissue is significantly higher than in gall tissue. It seems too high to be due to the difference in chlorophyll between leaf and gall tissue.

Mr. Andrew J. Dufner, S.J. (*Ore.*) is completing his doctoral studies in theoretical physics. A summary of his dissertation follows:

Since the discovery in 1957 of the violation of the parity of weak interactions, extensive research has been done on the electron decay (beta decay) of the nucleus. Beta decay is one of the principal manifestations of weak interactions. It is known that the spin orientation of the electron is a function of the spin orientation of the nucleus from which it emerges, and that the electron spin vector has a preferred orientation antiparallel to its momentum vector as it leaves the decaying nucleus. The present dissertation is concerned with the theory of the measurement of the latter phenomenon.

Electron spin and momentum correlations can be measured by a double scattering experiment. Beta-decay electrons are scattered once by a nucleus in metal foil through an angle of 90 degrees, and then a second time through some angle in a plane perpendicular to that defined by the incoming and outgoing momentum vectors of the first scattering process. Measurements made in this second scattering plane of the number of electrons as a function of angle exhibit an angular dependence which is a function of the spin-momentum correlation of the original beta-decay electron. The basic theory of the double scattering process was worked out by Mott as early as 1930. In the present study Mott's theory is extended to include the effects of the spin precession of the electron in the scattering process, and also the effect of multiply-scattered electrons.

Mr. William P. Lonc, S.J. (*Upper Can.*), who is completing course requirements for the Ph.D. in physics, is carrying out research on the semiconducting properties of monocrystalline black boron.

Mr. Donald J. Manson, S.J. (*Ore.*) is working on a physics doctoral dissertation concerned with measurements made by the satellite Explorer IV of radiation trapped in the geomagnetic field. The data being analyzed include the plasma trapped from the Argus nuclear explosions in 1958.

Mr. Robert F. O'Brien, S.J. (*N.E.*) is continuing research on "Electron and nuclear paramagnetism and energy exchange mechanisms." It is hoped that a general understanding may be gained of the coupling mechanisms responsible for dynamic nuclear polarization in electron-nuclear spin-coupled systems. This polarization is obtained by microwave power saturation of an allowed transition (Overhauser effect) or of a forbidden transition (Jeffries-Abragam effect). The experiment is directed toward the attainment of high levels of nuclear magnetic resonance enhancement in several sample types over the temperature range from 4.2 to 300°K. Mr. O'Brien previously conducted research on bactrian quadrupeds.

Mr. Augustin Udias, S.J. (*Antilles*) is currently doing doctoral research in geophysics. He spent the past summer in Europe compiling seismological data. He visited the seismological observatories of Upsala (Sweden), Kew, (England), DeBilt (Holland), Copenhagen (Denmark), and Uccle (Belgium). Microfilmed data from every station, covering most of the major earthquakes from 1950 to 1962, will be used in an investigation of focal mechanisms, based on the analysis of body and surface waves. The more recent methods of the determination of the source functions of an earthquake from the analysis of dispersed surface waves are compared with the classical methods of P-wave, fault plane solutions, and S-wave polarization methods. Data from a large number of earthquakes in one region offer a possibility of determining the orientation of regional stresses on the crust of the earth. This work is being sponsored by the Vela Uniform Program and is being directed by Fr. W. Stauder, S.J.

Mr. Robert F. O'Brien, S.J.

Weston Observatory. An assistant research director has been appointed to aid Fr. Daniel Linehan, S.J. in the business administration of the Weston Observatory. Contractual obligations of the observatory now exceed $400,000. Two new research assistants and a graduate assistant have also been added to the staff.

Two remote control seismic stations have been designed and constructed under the supervision of Mr. David Clarke, S.J. (*Ore.*). These stations are located at Caribou and Milo, Maine, 355 miles and 225 miles, respectively, from Weston. Several other stations are being constructed but are not in operation at this time. The output of three seismometers from each of the stations is used to modulate FM carriers which are transmitted over telephone lines and recorded on magnetic tape at the Weston Observatory. The signals are monitored by visible recorders. Seismic events are played back from the tapes through sub-carrier discriminators and recorded on a multichannel recording oscillograph which displays the record of all instruments simultaneously. The recording oscillograph can be played at various speeds to facilitate the record interpretation.

The nose cone of an Astrobee rocket borne instrument package, which was fired last spring, was instrumented by the Weston Observatory for the purpose of measuring magnetic field characteristics in the 150 km altitude range. Several other shots are in preparation for the coming year under the direction of Fr. Joseph B. Pomeroy, S.J. (*N.E.*). The information telemetered to the ground station by the instrument package is reduced at the data reduction facility of the observatory, which contains eight 6 foot racks of electronic equipment including a 1620 computer.

Mr. William Messmer, S.J. (*Mo.*) has programmed the 1620 computer for the location of earthquake epicenters. Mr. Roy Drake, S.J. (*N.Y.*) is presently directing the transference of seismic data from old earthquake records to IBM cards for future research purposes.

During the period from June through November the observatory monitored the series of high altitude nuclear test explosions detonated over Johnston Island. Various geophysical phenomena were recorded simultaneously on seven MINCOM instrumentation tape recorders. These phenomena included three components of earth motion, two components of telluric currents, and one of magnetic field total intensity. The latter was measured by a rubidium vapor magnetometer. Only one detonation, that of July 9, 1962 at 0900 GCT, showed positive results. No seismic activity was observed but magnetic and telluric effects were strikingly evident. It is significant to note that this same detonation created the inner Van Allen belt. The subsequent detonations, of smaller yield and lower in altitude, gave no record distinguishable from background noise.

Mr. David M. Clarke, S.J.

PROGRAMS OF INTEREST

In keeping with the present trend of up-grading science curricula and education at all levels, many new experimental programs are being tested each year. The content and results of these experiments should be of interest to all educators in the field of the physical sciences. In addition to the new programs cited in this BULLETIN's "Reports of scientific activity," the following have been brought to our attention.

St. Joseph's College in Philadelphia permits St. Joseph's Prep faculty members to attend classes in the evening division free of charge.

Students from lower Fairfield County, Connecticut, will have an opportunity to study in an area not duplicated in the usual high school offering—astronomy and space science. Patterned after a similar course at Yale University, it will be taught by a member of the Yale faculty with classes scheduled one night a week to avoid conflict with the varied programs of the schools in the area.

A pilot project in New York City for advanced placement students brings an instructor from Pace College in New York to teach a freshman college course in chemistry at Wingate High School in Brooklyn.

To avoid the difficulty a small college feels in competing with larger institutions in offering attractive research opportunities to prospective faculty members, Bowdoin College is experimenting with a program which emphasizes concentration rather than total cross section in a field. The plan grew out of a suggestion by Prof. Dan E. Christie of the mathematics department that several men with the same research interests be appointed to the faculty. This would foster an opportunity for research which, in turn, would advance the quality of the teaching. The program outlined by James S. Coles, president of the college, calls for the appointment of two new men with similar research interests instead of one new man to fill a vacant instructorship in the mathematics department. The teaching load formerly carried by one man will then essentially be shared by two instructors. This arrangement will give them time for research, and they will be able to discuss and criticize each other's work. This program is supported by a three-year grant of $31,320 from the Research Corporation, a nonprofit foundation.

A new approach to education for careers in engineering and applied science is projected for the school of engineering and applied science, George Washington University, Washington, D.C. The program, to begin in September, 1963, is designed to give the engineering student a more liberal education by giving him additional freedom of choice in course planning and more individual attention. The program abolishes the traditional freshman, sophomore, junior and senior years together with the rigid engineering curriculum traditionally found in engineering schools in the United States. Instead, George Washington University's approach provides for three forms, or levels, of accomplishment: the introductory, the intermediate, and the advanced. There will be no specific time or course requirements. Students will not move on to the next higher level on the basis of grades in courses taken; rather, they will do so on the basis of individual accomplishment. This will be determined by a requisite number of credit hours for each level, and a series of comprehensive examinations given periodically to "evaluate the individual, the knowledge he has gained, and the intellectual powers he has developed." There are no formal specifications for courses to be taken at the introductory or intermediate levels. Each student will set his own goals and standards, according to his interests, in consultation with a faculty adviser. On the advanced level, where a student concentrates his study and activity in a specific field of his choice, the pattern of work will be designated and related to the degree in his area of specialization. [For further details on this program, see *Chemical and Engineering News*, Nov. 19, 1962, p. 48.]

PERIODICAL CURRENTS

(SEPTEMBER THROUGH DECEMBER 1962)

For the Classroom

Sr. M. Alexine, S.C., "Experiment in teaching biological sciences," *The Catholic Educator* 33 (1962), 235–43. This is a detailed description of a successful high school biology course. With emphasis on cell physiology, protoplasmic biochemistry, and genetic continuity, each substantiated by experimentation, biology is presented to a variety of students as a living science.

John M. Culkin, S.J., "Educational television: first ten years," *The Catholic Educator* 33 (1962), 100–10; 186–87. A report on trends apparent in Fordham University's Second Annual Conference on Educational Television, July 16–20, 1962. Of these trends the following deserve mention: expansion, the team approach, the role of classroom teacher to *advance* learning, regional cooperation. Fordham plans three two-credit courses in educational television for the summer of 1963. A bibliography of free publications, books, and periodicals completes the conference report.

A. H. Livermore and F. L. Ferris, "The chemical bond approach course in the classroom," *Science* 138 (1962), 1077–80. An interesting report on the success of this program over the past three years. Imaginative examination and laboratory material is included, as well as an interesting sampling of the achievement tests given with this course.

Bro. Marcellus, C.F.X., "Do you have 20-20 vision for these new science courses?" *The Catholic Educator* 33 (1962), 244–48. A brief description of the four modern approaches to high school science. CHEM Study emphasizes the experimental and CBA the conceptual aspect of chemistry; PSSC the culturally integrated role of physics, and BSCS the investigative, dynamic development of biology.

Philip Morrison, "Experimenters in the classroom," *Science* 138 (1962), 1307–10. The author, professor of physics and nuclear studies at Cornell University, argues for the need of scientists at all levels to be interested in elementary school science training. "Only when research institutions, especially the universities, recognize that all learning, at every level, is partly their business can a self-sustaining educational system come into being, a system not cursed by intrinsic obsolescence." The article also contains some fine ideas on science teaching at any level.

"Symposium on the teaching of thermodynamics," *Journal of Chemical Education* 39 (1962), 490–528. Contains some very fine practical hints on the teaching of this elusive subject. The article should be useful to anyone teaching thermodynamics on a basic level.

Science and the Liberal Arts

"A symposium on the Jesuit liberal arts college," *Jesuit Educational Quarterly* 25 (1962), 90–102. Fr. Thomas R. Fitzgerald, S.J. proposes a core curriculum for the humanities including five areas: theology, philosophy, modern languages, English, and history. He begins by discussing what the humanities should do for the student.

Fr. Joseph P. Fitzpatrick, S.J. outlines how training in the social sciences help achieve the objectives of a general education: wisdom, knowledge, and skills for living in society. He stresses the need for more than a survey course, insisting on two semesters of a serious introduction to the basic concepts of the social science disciplines.

Fr. William G. Guindon, S.J., after an excellent discussion of the role of science in a liberal education, offers detailed suggestions on how to articulate that role for both the scientist and non-scientist. This article should prove quite helpful to BULLETIN readers trying to cope with the problems of both students in Jesuit schools.

Interdisciplinary topics

Leland C. Allen, "Binding of inert gas halogenide molecules," *Science* 138 (1962), 892–93; C. L. Chernick, et al., "Fluorine compounds of Xenon and Radon," *Science* 138 (1962), 136–37. These two articles should be of general interest to science teachers, especially those teaching high school courses, to update their notions about the so-called "inert" gases. The first article gives an electronic explanation of the existence of inert gas halides and predictions of the expected properties of these new compounds. The second article is the report of the group at Argonne National Laboratory which synthesized the compounds.

Bentley Glass, "Information crisis in biology," *Bulletin of the Atomic Scientists* 18 (October, 1962), 6–12. Dr. Glass makes some stimulating comments on how to cope with the ever-increasing flow of scientific knowledge. He suggests better review articles, teacher re-education, and modernizing science curricula.

Peter T. Mora, "Directiveness in biology on the molecular level?" *American Scientist* 50 (1962), 570–75. The author discusses the adequacy of a purely physical and chemical approach for scientific biology. The isolation of phenomena and exclusion of considerations of purpose, both proper to physics and chemistry, would seem to be insufficient to study or to explain the complex inter-relationships so essential to life.

Mina Rees, "The nature of mathematics," *Science* 138 (1962), 9–12; Leon Henkin, "Are logic and mathematics identical?" *Science* 138 (1962), 788–94. These two articles are fine supplementary reading for mathematics teachers interested in the purpose and nature of mathematics, also science teachers interested in the relation of mathematics to their respective fields.

Philosophy and Science

Edward MacKinnon, S.J., "Time in contemporary Physics," *International Philosophical Quarterly* 2 (1962), 425–57. This excellent article discusses the nature of time in the light of the conceptions of modern physics as well as those of various outstanding thinkers of the past 2500 years (Plato, Aristotle, Plotinus, Augustine, Aquinas, Newton, Kent, Reichenbach). The general outlines of the conclusion reached will be familiar to all those acquainted with scholastic philosophy: time exists formally in the mind, but has a foundation in reality. However, the manner in which this formula is specified is new: the basic intelligibility of time given in the flow of the subjective experience of the individual, which is measured by the structure of the entropy-directed causal network which is the universe.

James Collins, "Annual review of philosophy—philosophies of the sciences," *Cross Currents* 12 (1962), 362–65. A brief but valuable résumé of important current publications (and reprints), both hardcover and paperback, in the philosophy of science. Of special interest are references to recent writings on the Galileo controversy.

John J. Fitzgerald, "Philosophy, science, and the human situation," *Review of Politics* 24 (1962), 509–24. An "inquiry into man as a science-forming animal," with attention directed especially to the relation to the evolution of science of the great moments of philosophy and theology. A closely reasoned argument against any attempt to give an independent value to science or philosophy, i.e., to consider them in isolation from their "cultural matrix."

Ernan McMullin, review of James A. Weisheipl, O.P., *The Development of Physical Theory in the Middle Ages*, in the *International Philosophical Quarterly* 2 (1962), 483–89. This is not so much a review of the book in question as an attempt to get at the root of the suspicion which characterizes Aristotelian philosophy vis-à-vis modern science. Fr. McMullin gives considerable attention to the quality-quantity dichotomy in classical philosophy, and attempts to show that the traditionalists (as represented by Fr. Weisheipl) miss the point in their criticism of modern science as excessively quantified or mathematized.

History of Science

Solomon Bochner, "The role of mathematics in the rise of mechanics," *American Scientist* 50 (1962), 294–311. This article presents some observations on the relationship between mathematics and mechanics up to the early nineteenth century. Especially interesting are the author's comments on the relation between the science and mathematics of the Greeks and the early moderns.

E. U. Condon, "Sixty years of quantum physics," *Physics Today* 15 (1962), 37–48. This address by Dr. Condon traces the history of quantum theory in small jumps from Planck to the present. The term "quantum physics" is chosen rather than "quantum mechanics" to show how almost every field of physics has been affected in some way by the original hypothesis and its development.

F. Russo, S.J., "Le dixième congres international d'histoire des sciences (Ithaca-Philadelphia, 26 août–2 septembre, 1962)," *Revue des questions scientifiques* 133 (1962), 556–61. A report on the triennial meeting of the history of science section of the International Union of the History and Philosophy of Science. The author gives a European's impressions of the wide cultivation of the history of science in America, and of the large number of "amateurs" interested in the field. He indicates the major themes of the conference: the relation of the history of science to philosophy; the unity of the sciences; etc. He also summarizes the principal developments in eight particular areas.

Disarmament and Nuclear Testing

Cyril L. Comar, "Biological aspects of nuclear weapons," *American Scientist* 50 (1962), 339–53. A clear, balanced presentation of the biological problems resulting from nuclear explosions, especially those resulting from long-term, world-wide fallout.

Roger Hagan, "Atmospheric tests," *The American Scholar* 31 (1962), 521–40. The author claims that we are far too pessimistic politically speaking and are not facing up to realities on the physical and ideological-political level.

"Symposium on disarmament," *Bulletin of Atomic Scientists* 18 (September, 1962), 4–28. Four articles represent various arguments for disarmament and offer practical measures for its accomplishment. In "Zonal disarmament and inspection," Louis B. Sohn presents a practical solution of gradual denuclearization of certain areas. There would be limited inspection gradually extending from one zone to another. Igor Glagolev, a Russian, proposes the same plan in "Is disarmament practical?" and discusses the various theories behind the maintenance of a minimal military force. The next two articles, "Disarmament and strategy," by Hans Bethe, and "Responding to disarmament violation," by Roger Fisher, continue the general argument, supplementing it with examples from past negotiations.

In general, these and other articles from the *Bulletin of the Atomic Scientists* and similar publications present carefully reasoned arguments for nuclear disarmament, with only a tinge of the emotional appeal to fallout dangers.

Miscellaneous

F. J. Dyson, "Pugwash 1962," *Physics Today* 15 (1962), 24–26. The author discusses the ninth and tenth meetings of this now famous series of conferences between Western and Soviet scientists to discuss the impact of science on world affairs.

David L. Johnson and Arthur L. Kobler, "The man-computer relationship," *Science* 138 (1962), 873–79. On a common topic for discussion this article shows how the potential contributions of computers are crucially dependent on their use by very human human beings.

D. K. C. MacDonald, "How Conferences?" *Science* 138 (1962), 665–6. A well written and thought-provoking article on what makes for a successful science conference. It should be of interest to anyone in charge of organizing any sort of scientific meeting or conference.

Ernst Mayr, "Origin of the Human Races," *Science* 138 (1962), 420–22. This is a book review of Carleton Coon's *The Origin of the Races* (Knopf, 1962). For anyone interested in evolution, this is a good summary of some modern problems in seeking solutions to the question of the different races in the world.

John R. Sampey, "Maintaining and sustaining chemical publications in liberal arts colleges," *Journal of Chemical Education* 39 (1962), 585–6. A survey based on chemical abstracts of publications from liberal arts colleges for 1952–1961. Of the 45 leading schools 7 are Catholic; DePaul (5), Canisius (7), Providence (16), Holy Cross (22), St. Joseph's, Md. (24), College of St. Thomas (40), Xavier, Cincinnati (43). (The rank of each college is given in parentheses.)

F. Yost and E. C. Vicars, "The interdisciplinary laboratory program in materials sciences," *Physics Today* 15 (1962), 40–48. These two representatives of the Advanced Projects Research Agency relate the story of how various government departments decided to support basic research in universities on a large scale. They also give an account of the process of selecting twelve universities for multi-million dollar contracts and seventy-nine universities for equipment grants.

BROCHURES ON SCIENTIFIC EDUCATION

Aids and Sources for the Science Teacher. A guide to the materials and services offered to the high school and college science teacher by the following professional societies: American Institute of Physics, American Astronomical Society, American Chemical Society, American Geological Institute, American Institute for Biological Sciences, American Meteorological Society.

Educational Services and Programs of NASA. Office of Educational Services and Programs, NASA, Washington 25, D.C. A listing of workshops, institutes, space symposia, publications, films and other programs and services for educators, students and the general public.

Guide to Undergraduate Programs in Mathematics. Office of Education, United States Department of Health, Education and Welfare, Washington 25, D.C. Provides data on the kinds, requirements and characteristics of undergraduate degree programs in mathematics at each institution which participated in the survey of mathematics programs, conducted in 1961 by the Office of Education. Useful for high school students interested in studying mathematics in a college or university, and for mathematics departments in evaluating their own program. Also includes an annotated bibliography on careers in mathematics.

Science Course Improvement Projects. Courses, Written Materials, Films, Studies, Supported by the National Science Foundation. Publications Office, National Science Foundation, Washington 25, D.C. Report on all course content improvement projects, supported by the NSF up to October 1, 1962. Included are bibliographies on the SMSG, CBA, CHEM Study, BSCS, PSSC programs, as well as college programs.

A Survey of Federal Programs in Higher Education. Office of Education, United States Department of Health, Education and Welfare, Washington 25, D.C. This is a summary of a three-part survey by J. Kenneth Little, the director of the survey. Part I studies the various programs and participating institutions; Part II (by Dr. Orlans of the Brooking Institution) considers the effects, both good and bad, of federal programs on higher education; Part III presents observations, conclusions, and recommendations. A selected bibliography concludes the survey.

(Single copies of these brochures can be obtained free-of-charge by writing to the appropriate source cited in each case.)

OFFICERS OF THE ASSOCIATION

President: JAMES W. SKEHAN
Boston College, Chestnut Hill 67, Mass.

Secretary: JOHN J. MACDONNELL
College of the Holy Cross, Worcester 10, Massachusetts

Treasurer: JOHN S. O'CONOR
St. Joseph's College, Philadelphia 31, Pennsylvania

Chairmen: JAMES L. HARLEY, *Biology*
Georgetown University, Washington 7, D.C.

ARTHUR G. KEHOE, *Chemistry*
St. Peter's College, Jersey City 6, New Jersey

JAMES J. FISCHER, *Mathematics*
Loyola Seminary, Shrub Oak, New York

JAMES J. RUDDICK, *Physics*
Canisius College, Buffalo 8, New York

WALTER J. FEENEY, *Science and Philosophy*
Weston College, Weston, Massachusetts

CONTENTS